LIBRARY
OCT 6 - 1931

DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. XII. No. 142. OCTOBER, 1931. PRICE 1s. NET

IN THE ANTARCTIC WITH "DISCOVERY II."
(See page 314)

CONTENTS.

	Pages
Notes of the Month	307
A Message from General Smuts	309
Personal Recollections of Faraday	310
Faraday on Inertia of the Mind	311
"Discovery II" in the Antarctic	314
New Phase in Cancer Research	318
Early Peoples of Palestine ...	321
An Air Port for London? ...	324
The Excavation of Paestum ...	327
Drumming of the Woodpecker...	330
Man and the Dinosaur	331
Book Reviews	334

British Insect Life *for 10/6 only*

A popular introduction to Entomology by E. STEP, F.L.S.

"The best guide imaginable to the surprises of the insect world. Crowded with information."—*Daily News.*

With 8 illustrations in colour and 32 half-tone plates comprising 248 figures. Published at 25/-, offered at 10/6 (postage 9d.). On approval. Quote offer 52.

Special Offer of two books by Prof. Julian Huxley

ESSAYS IN POPULAR SCIENCE. Deals with the subject of thyroid insufficiency in human beings and animals; determination of sex; evolution and purpose, etc.

ESSAYS OF A BIOLOGIST. Including essays on—Progress: biological and other; An essay on bird mind; Sex biology and sex psychology.

Published at 7/6 each. Offered new at 3/6 Post Free. On approval. Quote offer 52A. each

Volumes of "Discovery"

Dates 1920-21-22-23 (Vols. I-IV)

We have a limited number of these vols. in stock which we are offering at 10/6 per vol. (post free). Bound in cloth. Second-hand, in good condition.

Any vol. sent on approval. Quote offer 52B.

FOYLES FOR ALL BOOKS

119-125 Charing Cross Road, London, W.C.2. 'Phone: Gerrard 9310 (7 lines)

Radio simplified and identified

. . . . . stations

by name as well

as wavelength

. . . automatic

change from short

to long waves

. . . automatic

change from Radio

to Gramophone

. . . all with

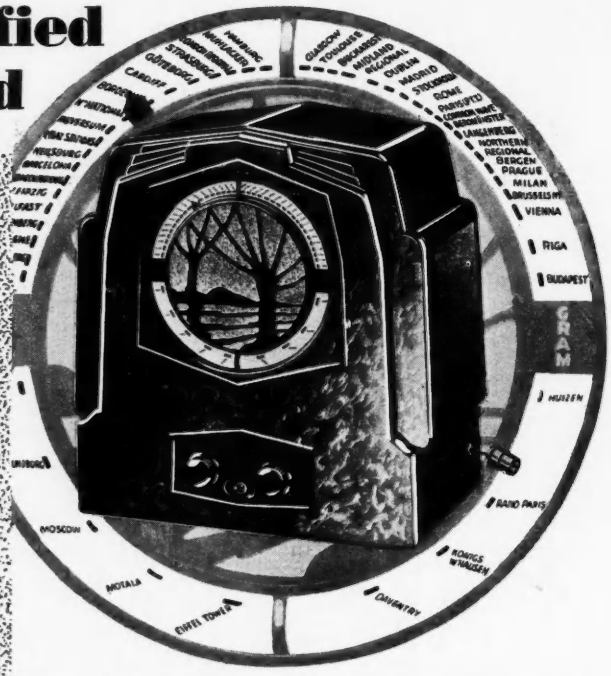
ONE KNOB CONTROL

EKCO

ALL-ELECTRIC

RADIO RECEIVERS

Advt. of
E. K. COLE, LTD.
Southend-on-Sea



What station is that?—How do I get Rome?

The new Ekco Station Indicator answers these questions instantly by showing the NAME of the station to which it is tuned. All the principal British and Continental programmes awaiting your choice—just turn the pointer to NAME of the station you want, that's all. *No other radio possesses such a convenient, simple and unique control.*

EKCO R.S. 3. CONSOLETTE

(combined 4-valve set and speaker—illustrated above).

The most up-to-date circuit and valves with a moving coil speaker of the latest type, amazingly realistic in tone. All-electric (A.C. or D.C.), no batteries—no accumulators—no trouble. Running costs only a few pence a week. A choice of stations without aerial or earth. Tone and volume controls. Connexions for gramophone pick-up. Many other exclusive features. Cabinets of beautifully figured bakelite in dark jade, mahogany or walnut. The highly-polished surface will not warp, scratch or discolour.

AND SO EASY TO BUY!

20/- with order and 11 monthly payments of 49/- or 30/- with order and 23 monthly payments of **25/-**

(Cash price 24 guineas)

(Other Ekco Receivers from £10 17s. 6d.—or 10/- a month.)

Worth knowing more about! *Post now for full details.*

OLYMPIA Sept. 18th—26th STAND 26.

J. E. SEXTON,
RUGBY CHAMBERS,
GREAT JAMES STREET,
LONDON, W.C.1.

Wobum

DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. XII. No. 142. OCTOBER, 1931. PRICE 1s. NET

Trustees: Sir J. J. Thomson, O.M., F.R.S., Sir F. G. Kenyon, K.C.B., F.B.A., Professor A. C. Seward, Sc.D., F.R.S., Professor R. S. Conway, Litt.D., F.B.A.

Publishers: Benn Brothers, Ltd. All communications respecting editorial matters to be addressed to the Editor; all questions of advertisements and subscriptions to the Manager.

Offices: Bouverie House, Fleet Street, London, E.C.4. (Closed on Saturday.)

Telephone City 0244. Telegrams: Benbrolish, Fleet, London.

Annual Subscriptions 12s. 6d. post free anywhere in the world. Single numbers, 1s. net; single back numbers more than two years old, 1s. 6d. net; postage 2d.

Binding cases, price 2s. 6d. net each; postage 6d.

Notes of the Month.

There could be no more fitting introduction to our British Association Centenary Number than the special message which General Smuts has addressed to readers of *Discovery*. The new President believes that the greatest age of science is still to come and that it is destined to carry us very far in the direction of a new interpretation of the things that matter most. The enthusiasm which the layman feels for science to-day is indicated by the letters which we are continually receiving from readers in all parts of the world; and the centenary celebrations of the British Association are certainly in striking contrast to the first meeting a hundred years ago in York. In his new book, "Advancing Science," Sir Oliver Lodge describes the attitude of the public and the Press to the new "society of British cultivators of science"; and in *Discovery* for September Mr. Howarth recalled that even fifty years after its foundation there was widespread opposition on the part of those who declared that the British Association had finished its work. The application for tickets for the centenary meeting is a welcome indication that the message of science is recognized, in the words of General Smuts, "as the most important thing in the world of to-day." A short forecast of the Presidential Address, authorized by the British Association, appears on another page.

* * * * *

The progress of the Haardt Expedition, which aims at establishing a motor track through central Asia, has been watched with interest, and news was recently received that the party under the direction of M. Haardt was about to attempt a crossing of the Himalayas from Kashmir. The difficulties of the crossing are described in the latest report which has just reached London. The expedition is being made in caterpillar cars, and as the route which is being followed is little more than a caravan track, the difficulties are considerable. In addition, the party has had to cope with heavy mountain storms and at one point twelve feet of snow was encountered. Progress was necessarily slow and according to the report only eighteen miles were covered in three days. After travelling three hundred miles in three weeks, the road became so bad—in many cases it entirely disappeared—that the cars had to be abandoned and the party is continuing on ponies. A second party, led by Lieutenant Point, is crossing from the other side, and it is understood that the leader hopes shortly to dispatch three cars to meet M. Haardt's party.

* * * * *

The important part which X-ray analysis is likely to play in industrial research is forecast in the first report of the committee which has been investigating this work under the chairmanship of Sir William Bragg. The committee was appointed by the Department of Scientific and Industrial Research three years ago. The report stresses the need for closer co-operation between X-ray workers, specialists and manufacturers, for it is pointed out that the manufacturer does not always select for X-ray examination the problems which are most amenable to such treatment; he tends to select problems in which all other methods have entirely failed and in which the chances of X-ray methods being useful are not very high. The work of the committee has so far been mainly of an exploratory character; in many of the investigations it has been the aim rather to test the possibilities of the method than to endeavour to solve specific problems. Much useful work has already been done, however, and among the first problems tackled was a study of magnet steels with special attention to the curious phenomena

of "spoiling" and "recovery" in magnets. An X-ray examination showed more clearly than any other method the structural changes which follow heating of the steel and that "spoiling" is due to the presence of at least two distinct crystalline constituents. A survey of materials used in the paint industry has emphasized the fact that the size of elementary crystals is of great importance in connexion with the quality of many materials. It is clear that X-rays have decided possibilities in attacking industrial problems once the initial difficulties are overcome.

* * * * *

Sir Arthur Thomson's picturesque description of man as "a walking museum of relics" suggests many interesting reflections. Lecturing at Oxford, Sir Arthur said that there were in man's development some distinctly simian features, and a baby's power of gripping with its toes pointed back to an "arboreal apprenticeship." He suggested that the appearance of tentative man was connected with the abandonment of arboreal and the assumption of terrestial habits and that this change was correlated with a shrinkage of the forests during a period of aridity in the late Miocene or early Pliocene Age. Forced from the trees, man would have to face a keen struggle for existence in which brains counted for more than brawn.

* * * * *

The Chinese authorities have now refused to grant to the Central Asiatic Expedition of the American Museum of Natural History the permit which would enable it to continue palaeontological and geological exploration in Mongolia. In the last eleven years this expedition, under the leadership of Dr. Roy Chapman Andrews, has visited the Gobi Desert five times and, in opening up and developing one of the greatest fossil beds in the world, has made some remarkable additions to palaeontological science, of which the famous dinosaur's eggs are, perhaps, the most familiar to the general public. This decision has fallen at a juncture particularly unfortunate for science, for in its last season's work the expedition had discovered new deposits of Pliocene Age which it was hoped to explore fully in 1931 and 1932. It was confidently expected that important results would accrue, possibly with a bearing upon the problem of early man. The Chinese authorities state that it is no longer necessary for American scientists to visit Mongolia, as the Chinese Government is organizing an expedition for scientific research on the western frontier which will work in Mongolia. It is evident, however, from the treatment meted out to Sir Aurel Stein, and to the Swedish and French trans-Asiatic expeditions, that China has closed her door to foreign scientific exploration. It is particularly unfortunate that at a time of financial stringency when it is becoming increasingly difficult to obtain support for scientific research, no less than four expeditions fully equipped and ready to take the field should be debarred from their objectives.

* * * * *

Few discoveries in the field of medicine have aroused more public interest in recent years than the new method of diagnosing cancer evolved by Dr. Bendien. He holds the view that cancer is a local disease which cannot develop except in the event of a specific abnormality of the serum. His aim is to detect the specific abnormality, not the actual cancer. The Dutch physician's work is discussed by a medical correspondent on another page, who also reviews recent progress in the study of cancer in this country. If it is established that cancer represents merely a local expression of a general state, as Dr. Bendien believes, a new view of the disease will have been arrived at and a new hope of treatment obtained. His work may prove an immediate boon if it enables the presence of cancer to be detected at an earlier stage than is now possible. Dr. Bendien's investigations are directed towards the discovery of a form of cancer known as carcinoma; it will not detect the other form known as sarcoma. Our contributor points out that time must, of course, elapse before final conclusions can be reached.

* * * * *

Mr. R. L. Mégroz's book, "Ronald Ross" (Allen & Unwin), is a fitting tribute to the rare and many-sided genius of a remarkable figure. Sir Ronald Ross is of course, best known for his discoveries in the field of tropical medicine and particularly for his work in banishing the mosquito from the Panama and thus saving millions of lives. But his contributions to music, poetry and mathematics are not generally known and have not received the recognition which they deserve. Perhaps the most fascinating chapters of the book are those devoted to the discovery of the malaria parasite. The author vividly describes Ross' difficulties and suffering in his long and patient quest, and how at the critical moment his vital work was interrupted by the stupidity of the military officials. It will be recalled that, as a consequence of this interruption a determined attempt was made by an Italian worker to pirate Ross' discovery, happily without success. The story of Ronald Ross' life and work in many spheres is an inspiring one and Mr. Mégroz's book deserves to be widely read, especially by the younger generation.

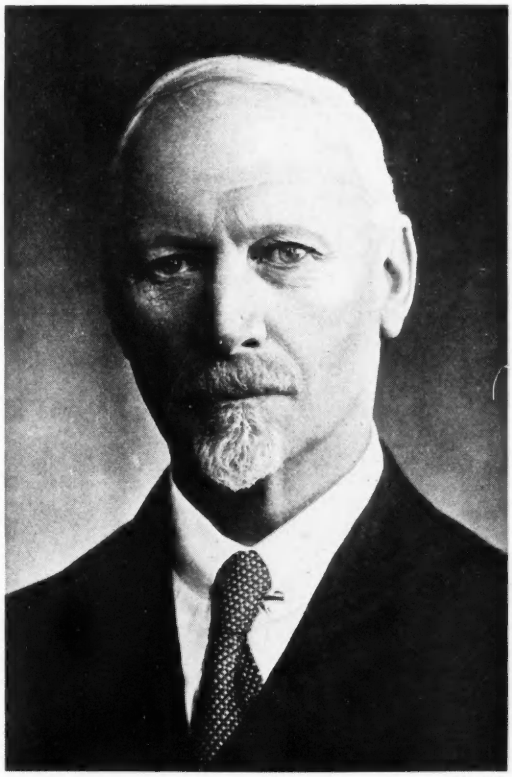
Science the New Factor in Human Destiny.

By General the Rt. Hon. J. C. Smuts, P.C., C.H., F.R.S.

President of the British Association, 1931-32.

We are privileged to publish a special message which General Smuts, as the new President, has written for the British Association number of DISCOVERY. *In addressing "all those throughout the world who are watching the progress of science," he expresses the belief that the greatest age of science is still to come.*

IN the midst of all the world troubles of to-day, the Centenary of the British Association comes as a welcome reminder of the things that fundamentally matter most, and of the forces which are really reshaping the modern world. It will help to give us a juster perspective and prevent us from laying undue emphasis on our present perplexities, which are after all only a passing phase in our economic evolution. For beyond all doubt science is the great new factor in human destiny. Already it has wrought the most profound material changes in our civilization. And it is only at the beginning of its real task.



Vandyk.

GENERAL SMUTS.

Perhaps it was only natural that in its initial stages it should have made its main contribution to the material aspects of our progress, and should have been mainly of a mechanical character. But in the decades to come, it is bound to affect more and more closely the social and ethical aspects of human life. Its triumphs in manipulating the forces of nature may be as nothing compared to what it will yet do in opening up new knowledge and control of human nature and adding fresh values to human existence.

I myself believe that the great age of science is still coming, and that it will yet achieve far more than merely effecting mechanical improvements in our conditions of life. Already we see the beginnings of a new world-view and a new attitude to life, which reaches beyond external conditions and touches the spiritual values of life. And I believe that science is destined to carry us very far in the direction of a new interpretation, a real transvaluation of the things that matter most to us.

After all, what we humans are after is truth and beauty and goodness. All knowledge and power are but means to these great ends. And science is not only creating these means at a phenomenal pace: it is also beginning to make its contribution to the shaping of the ends themselves. Its true meaning and function may yet be the spiritual revaluation of life, and the endless enrichment of human nature through a more intimate relation to the world of which we form a part. The message of science, of which this Centenary is the reminder, is the most important thing in the world of to-day. *Discovery* is helping to spread this message and I am pleased to address, through its pages, not only the members of the British Association, but all those throughout the world who are watching the progress of science.

J. C. Smuts

Personal Recollections of Faraday.

By Michael Grabham, M.D., LL.D.

Dr. Grabham was born in 1840 *and can claim to be the senior member of the British Association. He was intimately associated with Faraday, and his personal recollections of the great scientist are probably unique.*

THE original instruments by means of which Professor Wheatstone showed subaqueous transmissions of signals in the presence of Prince Albert have fallen into my hands, and I lent them at the recent King's College centenary for his great-grandson, the Duke of York, to manipulate. The famous scientist, Professor Wheatstone, made practical application of Faraday's experimental results as fast as they were issued, and his famous electric clock in which the pendulum is a coil of wire moving in a magnetic field and transmitting a half-second impulse to many secondary time-keepers is a marvel of ingenuity.

There were originally, I believe, five such clocks; one of these has been a constant interest in my Madeira home for sixty years; the migration of the others should be easy to trace, but it would be a misfortune if we cannot show in London so tangible an instance of Faraday's applied genius. Faraday was constantly in and out of King's College in my early years of 1849, '50 and '51. He would have long talks with the chemist, Professor Daniels, who had just then brought out his copper sulphate constant cell—a dictation rather than talk; but his visits were chiefly concerned with Professor Wheatstone, mostly brief with a few emphatic words, simple but almost dictating.

Faraday's Personality.

Wheatstone and Daniels, both highly cultured men, always seem in my memory to have been suppressed and silent in Faraday's presence; he was emphatic, never dogmatic, and little reply was ever made to his assertion of facts or suggestion. In solving a difficulty he was wonderful, and his neat manual dexterity was bewildering. Wheatstone, in 1852 I think, was then perfecting his wonderful electric clock and his whole mind was for a while wrapt up in that mass of invention. Faraday was full of suggestion, equally interested in that wonderful escapement with its gliding pallates as in the built-up magnets along which from side to side the wire-coiled pendulum moved in a viscid magnetic field whose resistance lessened when more secondary clocks were in circuit. Faraday and Wheatstone were never tired of explaining the enigma that the clock required less weight to keep ten secondary clocks in action than five with their greater resistance in the magnetic field. This great clock suffers a two-hourly correction from a distant regulator by means of a metallic ball, which is ingeniously raised or lowered as the error may require.

A Fascinating Clock.

In Madeira I have supplemented the utility of the Wheatstone clock by adding a simple commutator to work a number of Hipp clocks with a minute impulse; but the silent gliding movement of the Wheatstone clock is more fascinating. I have brought over to London one of Wheatstone's secondary clocks to show the delicacy of structure and the astatic arrangement of its magnets. Beside the clock, among other treasures, Wheatstone had a beautiful electrophorus in which when the cover is lifted a spark ignites a jet of hydrogen and a candle beyond. The hydrogen comes from a beautifully cut-glass generator. The instrument was associated with Faraday, who never passed it by without notice. Near the electrophorus in Wheatstone's cramped laboratory stood an elaborate dipleidoscope which never failed to engage Faraday's notice and also a fine Richie reverser.

All these have, fifty years since, passed into my possession, and I am still puzzled to think why, at Wheatstone's death or retirement, they were allowed to stray from King's College. The dipleidoscope and the gravity escapement are both due to a gifted inventor who worked at my Quinta. In those early days there were no trains to catch and the dipleidoscope was our first means of accurate time-keeping. To-day through the interstellar ether we hear Big Ben at Madeira as clearly as when we stand on the Thames Embankment.

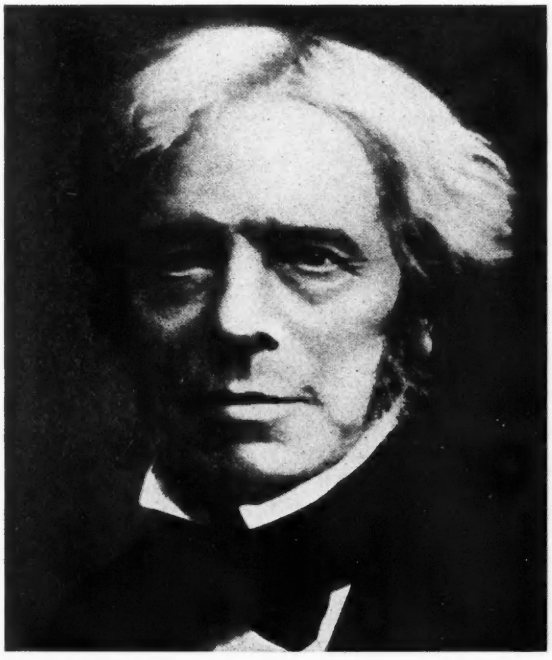
Faraday was frequently to be found at the house of a clever fellow who worked for everybody. For Faraday he made an induction coil with a primary winding of 150 feet of wire, overlaid with a secondary coil of 1,000 feet which gave a formidable spark. My last sight of Faraday was at Hampton Court, I think in the autumn of 1857, and I still recollect vividly his smile of recognition.

A Little-known Discourse by Faraday.

By D. F. Fraser-Harris, M.D., D.Sc.

In 1899 Professor Fraser-Harris put forward his theory of mental inertia. Later he was interested to learn that eighty years before Michael Faraday had read a paper on the same subject, which is here discussed.

It would be a mistake to suppose that all Faraday's interests were in the realm of physical science, important and far-reaching as these have proved to be. When quite a young man, Michael Faraday enunciated the principle of "mental inertia," that property of the mind to resist change on the one hand and to persist in its *status quo* on the other. As Faraday conceived it, mental inertia was the basis of habit. He was only twenty-seven years old when on 1st July, 1818, in London he read before the now long defunct City Philosophical Society a paper which showed that already he was thinking even of mental phenomena in the most comprehensive of terms and on the broadest of principles.



MICHAEL FARADAY.

The title of the lecture, for such it is rather than a mere communication, was, "Observations on the Inertia of the Mind." The following quotations will show the trend of the young philosopher's thoughts: "There is a power in natural philosophy of an influence universal and yet withal so obscure in its nature, so unobtrusive, that for many years no idea of it existed. It is called 'inertia.' It tends to retain everybody in its present state and seems like the spirit of constancy impressed upon matter. Whatever is in motion is by it retained in motion, and whatever is at rest remains at rest under its sway. It opposes every *new* influence and strengthens every *old* one. Is there anything in the human mind which seems analogous to this power? Is there no spiritual effect comparable to this corporeal one?

"What are habits? Old prejudices? They seem something like a retention in a certain state due to somewhat more than the active impulses of the moment. As far as regards them, the mind seems to remain in the state in which it is, and the words which enunciate part of our natural law will describe exactly the effect . . . to illustrate at once the force of mental inertia, to retain the mind desirous to set about a new affair, how facile our progress when once engaged, a very little delay illustrates more or less the inertia of the passive mind, every new observation, every fresh discovery, that of the active mind. . . .

"Inertia is an essential property of matter; is it a never-failing attendant on the mind? I hope it is, for as it seems to be in full force whenever the mind is passive, I trust it is also in power when she is actively engaged. Was the idle mind ever yet easy to be placed in activity? Was the dolt ever yet willing to resign inanity for perception, or are they not always found contented to remain as if they were satisfied with their situation? . . . Apathy will represent the inertia of a passive mind, industry that of an active mind. . . . I have endeavoured to establish the analogy between habit of industry and the inertia of a moving body. I have said that the inertia of matter is continually blended with other forces which complex its results and render them apparently contrary to their cause, and also that in this respect it resembles the inertia of the mind."

*

In such old-fashioned language and rather involved style did Faraday endeavour to lay before the members of the City Philosophical Society one hundred and thirteen years ago the conception of mental or psychic inertia. Examples of this principle were given, and it is not difficult to add others to Faraday's list. In more modern language, he recognized mental inertia as the maintenance of the *status quo ante*, and mental momentum as the continuance of a state of mental activity. "Habit," as a term, covers both states, for by "habit" we may mean either continuance in our accustomed way or a decided objection to change from it.

A disinclination to alter one's mode of life or outlook on life, a desire to be left undisturbed in the even tenor of one's way, some cases of a wholly irrational dislike of change are examples of mental inertia, while a tendency to do as we have always done, to act and think as we have always acted and thought, to persevere in a certain course of behaviour for no other reason than that we have always done so, are examples of mental momentum. The bigot who will not embrace a new idea exemplifies the mental inertia of position; the fanatic who persists in his hot-headed career in spite of all opposition and counter-agreement is exemplifying mental momentum.

Many years ago—in 1899—I came to the conclusion that the behaviour of living matter (protoplasm) could not be adequately described in terms of affectability alone, and affectability or "irritability" being that universal property of living matter in virtue of which it responds to a stimulus. It seemed to me that all living matter exhibits another fundamental but complementary property which I called "functional inertia." It expressed itself in the two phases, the functional inertia of rest and the functional inertia of movement or functional momentum. My first public communication on the subject was at the British Medical Association's meeting in Ipswich in August, 1900.

Functional Inertia.

I defined functional or protoplasmic inertia as that property of living matter in virtue of which it tends to maintain the metabolic *status quo ante*, even although it may have received a stimulus to change that state. Thus the "latent period" of muscle, gland or nerve-cell is the time-expression of the functional inertia of rest. I defined functional or protoplasmic momentum as that property of living matter in virtue of which the protoplasm, having responded to a stimulus, continues to exhibit its activity (or inactivity if that was the *status quo ante*) after the stimulus has ceased to exist. Thus periods of post-stimulant activity or "after-discharges" are time-expressions of functional momentum.

A striking example of functional inertia in both its phases is afforded by the behaviour of the beating heart when subjected to an inhibitory stimulus through the vagus nerve. If one is recording the contractions of the heart, and marks the moment of arrival of the stimulus, it is seen that the heart makes one or two beats before it stops. Now, on cutting off the stimulus, it is found that the heart does not at once resume beating but only after a period of inactivity (post-stimulant inhibition). The beats given before it stopped are an expression of its "functional inertia" proper, its remaining quiescent after the inhibitory stimulus was withdrawn, is the expression of its functional momentum. It is interesting to note that functional momentum is in this case expressed by *in*activity, because inactivity (inhibition) was the *status quo ante*.

Examples from Botany.

The botanists soon gave us examples of both the initial phases, but seemed more particularly interested in protoplasmic momentum. Thus it was pointed out that the opening and closing of certain flowers went on for several days after the plants had been placed in the dark. Deciduous trees continue to shed their leaves in the autumn even after they have been transplanted to a country where the vegetation is ever-green.

The diurnal curve of bodily temperature maintains its sub-tropical character for some weeks after a person has been living in the temperate zone. The great excess of anti-toxin molecules produced after the stimulus of the toxin is long past is a good example of functional momentum in animal metabolism. Early in 1901 the late Professor Adami, F.R.S., adopting the principle of functional inertia, referred to it as the "law of habit." In a private communication he informed me how delighted he had been to read the paper of September, 1900, as it had supplied him with exactly the conception and nomenclature he was in search of at that time. In his "Medical Contributions to the Study of Evolution" (1918) he expounded my views on functional inertia with considerable insight. The late Professor Noël Paton in his "Physiology of the Continuity of Life" (1906), when treating of heredity, made extensive use of the conception of protoplasmic inertia especially in its aspect of momentum.

Early in 1908 I published a monograph, "The Functional Inertia of Living Matter" (Churchill),

in which I dealt very fully with both protoplasmic and mental inertia. I contended that there was a mental or psychic inertia because there was an underlying protoplasmic inertia. Since the quality and character of the mind is conditioned by that of the cerebrum, so the mind possesses inertia in both its expressions because the living matter, its locus, possesses inertia. I was not using "functional inertia" as a mere metaphor or analogy, but insisting that inertia was a second fundamental property of living matter. Its use as a metaphor is very extensive, all sorts of expressions having been used—"the inertia of the Boers," "of non-voters," "of crofters," "of the industrial market," "of the age," "of circumstances," are some I have collected.

Mind and Matter.

This dependence of mental inertia on the underlying living matter of the nervous system is recognized by Professor Spearman, F.R.S., of University College, in his works, "The Nature of Intelligence" (1923) and "The Abilities of Man" (1927).

Professor Spearman's words are: "From the physiological standpoint it would appear to depend largely on some excitement which persists residually in the neurone after the cessation of the process that originally excited it." And "Spearman's Law" is said to be, "cognitive processes always both begin and cease more gradually than their apparent causes." Spearman's pupil, Professor Ll. Wynn Jones of Leeds, has applied methods of measurement to cases of mental inertia; his results were communicated to the Glasgow meeting of the British Association in 1928.

From the first I had seen that all mental states—sensations, emotions and cognitions—exhibited inertia. I regarded, for instance, as examples of mental momentum, the persistence of retinal impressions and, in particular, after-images which are obviously the basis of the kinematographic illusion of movement.

In course of time, I found that Professor MacKeen Cattell had long before said, "Inertia is a property of our sense-organs. The molecules of the cells are only set in motion after they have been worked upon by a stimulus of a certain strength for a certain time, and the motion continues after the stimulus ceases." But, indeed, psychic momentum had actually been described by Hobbes (d. 1679) when he wrote, "Like water troubled, an organ of sense will remain in motion after the removal of the exciting agent."

Sir Charles Sherrington, F.R.S., in his presidential address to the British Association in 1922, expressed the matter with his customary lucidity (*Nature*, 9th September, 1922, p. 349): "How should inertia and momentum affect non-material reactions? Quick though nervous reactions are, there is always easily observed delay between delivery of stimulus and appearance of nervous effect; and there is always the character that reaction once set in motion does not cease very promptly. Just the same order of lag and over-run, of want of dead-beat character is met in sense-reactions. The sensation outlives the light which evoked it, and the stronger the reaction, the longer the sensation persists."

Another philosophical biologist, Sir J. Arthur Thomson, in his extremely thoughtful Gifford lectures at St. Andrews (1915-16), published as "The System of Animate Nature," made a most extensive use of the conception of functional inertia, both in the protoplasmic and in the psychic realms. Some of his expressions are: "A sort of momentum in the organism itself," "organic momentum," "momentum in metabolism." Heredity he regards, as I did originally, as an expression of "racial inertia." Neural activities without a conscious correlate of course exhibit inertia in both its phases. On this point Professor Spearman writes: "It even extends its manifestations down to non-cognitive levels, being especially noticeable in the gradual rise and fall of sensory intensity as also in the latency and after-discharge of reflexes."

The behaviour of the reflex nerve-arc has recently been made the subject of a very careful experimental study by Dr. E. A. Blake Pritchard (*Brain*, Vol. 53, 1931), in which he frankly has recourse to the conceptions of "inertia of the system" and the "momentum of the system" to explain satisfactorily his observations on the behaviour of the motor neurones of spinal reflexes.

Faraday the Pioneer.

Thus has the conception of mental inertia been stabilized and extended since Faraday's time. It is distinctly interesting to us to know that not all of Faraday's thoughts were confined to the sphere of physical phenomena in which he achieved such success for himself and advancement and comfort for mankind. Faraday pondered also on the things of the mind; and long before he became famous, he discoursed on a general and fundamental property of mind, namely, its inertia, a term he applied as an analogy with that property of non-living matter. To-day we believe in "mental inertia" and derive it from the antecedent functional inertia—a fundamental and universal property exhibited by all living matter from the white blood-corpuscle to the brain of man.

In the Antarctic with the "Discovery II."

By N. A. Mackintosh, D.Sc.

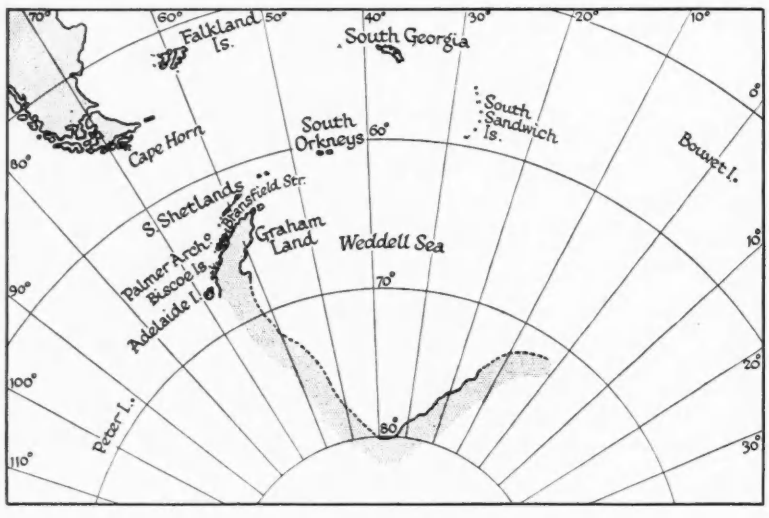
The research ship "Discovery II" has just returned from a voyage to the Antarctic in the interests of the whaling industry, and the work is here described by a member of the expedition. While the distribution of whales was the primary object of research, much progress has also been made in the study of oceanography.

AFTER a voyage of eighteen months spent in research in the Antarctic, the "Discovery II" recently returned to England and is now about to start on a second cruise. She was built in 1929 for the Discovery Committee which acts on behalf of the Government of the Falkland Islands, and the main purpose of her work is to study the distribution, migrations and other habits of whales. The rapid development of whaling in the southern ocean has involved the destruction of these animals on a scale which threatens sooner or later to bring about the collapse of the industry, but much must be learned of the habits of whales before any suitable restrictions can be applied.

Investigations were started in 1925 when Captain Scott's old ship, the "Discovery," sailed on a two years' cruise, and were continued later by a smaller ship, the "William Scoresby." In 1929 the "Discovery" was chartered to the Australian Government for Sir Douglas Mawson's recent expeditions, and the "Discovery II" was built to continue investigations on whales. There are thus two ships under the name of "Discovery" which have made recent expeditions to the Antarctic. The investigations of the "Discovery II" are under the leadership of Dr. Stanley Kemp, F.R.S.

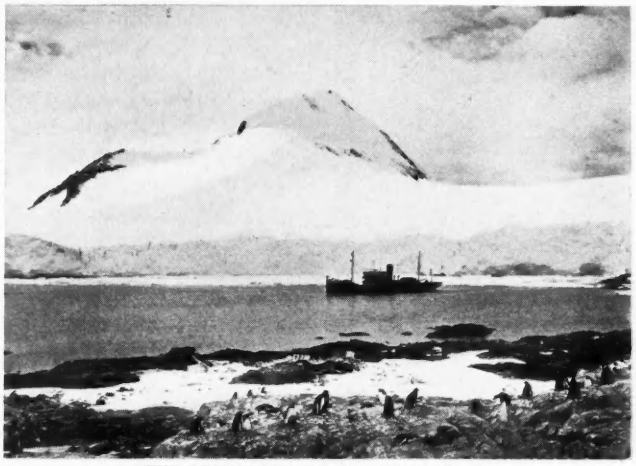
It must be explained that the distribution of whales depends very largely on the distribution of their food, and this, curiously enough, consists of shrimps, known to the whalers as "kril," which are found in vast shoals over immense areas in the Antarctic. The shrimps in their turn depend on the microscopic plants or "diatoms" on which they feed, and the growth and distribution of both is governed by the temperature and chemical condition of the water, which in fact control all the minute forms of life in the ocean. The sea appears to the eye as a vast expanse of water, much the same in one place as it is in another. But when we begin to probe beneath the surface with the instruments of modern research it is seen in quite a new light; and with its varying physical and chemical constitution, its superficial and deep currents, and its variegated population, we can construct a map of a stretch of ocean as complicated as one of the land.

In order to arrive at an understanding of the habits of whales it is necessary to study all these things and an elaborate scientific equipment is needed. The "Discovery II" is a steamship of 1,086 tons, built of steel with special protection against ice. There are biological and chemical laboratories and a complete equipment of winches, davits and reels of wire for lowering nets and water-sampling bottles to any depth. A variety of instruments and appliances are carried which are too numerous to mention here. The work is in general conducted in the following



MAP OF THE ANTARCTIC SECTOR.

manner. A series of routine observations including a sounding, samples of sea water and temperature readings at different depths, and hauls both vertically and horizontally with fine meshed nets, are taken at selected positions with the ship stopped or steaming slowly ahead. Each set of observations is called a station, and lines of stations are planned so as to cross the various areas frequented by whales and the current systems which influence them.



THE "DISCOVERY II" IN PORT LOCKROY.

The "Discovery II" was built in 1929 to continue the investigations on whales when the "Discovery I" was chartered to the Australian Government for Sir Douglas Mawson's recent expeditions. All the photographs are reproduced by permission of the Discovery Committee.

The "Discovery II" left England in December, 1929, and calling at Madeira, St. Vincent and Montevideo we reached South Georgia about a month later. This island, the principal centre of the whaling industry, and the starting point for several previous Antarctic expeditions, lies some eight hundred miles south-east of the Falklands. It is composed of a range of high mountains, rising abruptly from the sea and covered with immense glaciers. It has no natural resources, but there are several good harbours in which the whalers have established their land stations.

We started work with an intensive survey of the whaling grounds within a radius of a hundred miles from South Georgia, which, with the usual intervals of bad weather, was completed in three weeks. A survey of this kind is attended with not a little discomfort when each station involves three or four hours' work and there is often only an hour's steaming before the next begins. Sometimes one must go without sleep for thirty-six hours, and the best chance of a good night's rest is a gale sufficiently violent to stop the work. On the completion of the survey we set out from South Georgia in a south-easterly direction towards the South Sandwich Islands. This is a chain of volcanic islands which in normal seasons are partially surrounded by pack ice and so difficult to approach that very little was previously known of them. They were, however, unusually clear of ice this season, and we took the opportunity of examining them in the course of our visit. Three weeks were spent in a running survey which has resulted in the first reliable chart of the whole group and a very complete set of photographs. Several attempts were made to land, but the difficulties are so great that only one was successful. It would indeed be hard to imagine any less hospitable islands. There are no harbours and a landing can be made only in a small rowing boat on open beaches, often exposed to sulphurous fumes issuing from the craters and fumaroles which are a feature of several of the islands. There are eleven islands in all, about half of which are actively volcanic. The rest are covered by an ice sheet up to two hundred feet thick.

After more work at sea and a brief visit to South Georgia, we started for the South Shetland Islands. Our course was set first to the north-west corner of the Weddell Sea towards a point rather to the south-east of the Shetland group, but heavy pack ice was encountered and a detour had to be made to approach the Shetlands from the north. An attempt was made to do some work in the Bransfield Strait (an important haunt of whales between the islands and Graham Land), but with the approach of winter violent gales and difficult ice conditions rendered further observations so difficult that it was decided to proceed with the next part of the programme—a line of stations northward from the Shetlands to Cape Horn. The four-hundred-mile passage between these points is known as the Drake Strait, and through it flows one of the world's major current systems—the west wind drift which flows from west to east throughout the Southern Ocean. On the north side of the strait is comparatively warm water from the Pacific, while on the south side is cold water of Antarctic origin. Since leaving South Georgia we had experienced a succession of gales and fogs, but fortunately the neighbourhood of the Horn did not live up to its evil reputation and we were able to complete the passage in a few days. The autumn being now well advanced the

THE MOUNTAINS OF PALMER ARCHIPELAGO.

The ice-clad mountains and winding channels of the Palmer Archipelago, through which the ship passed, provide some of the most impressive scenery in the world.

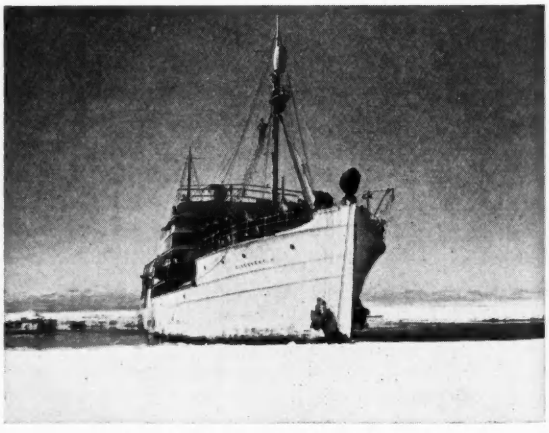
"Discovery II" returned to South Georgia and having re-fuelled, set out for Capetown towards the end of May. Whaling ceases during the Antarctic winter from May to October, but is continued on a smaller scale off the South African coasts. The next few months were occupied with work round these coasts and with the overhaul in dry dock which is necessary to a ship which has spent five months almost continually at sea in ice-infested and stormy regions.

At the beginning of October we sailed again for the Antarctic, and reached Bouvet Island after about ten days steaming. This has the distinction of being the only island in the world which has no other known land within a thousand miles of it in any direction. It is a rocky island covered with ice and, like the South Sandwich Islands, quite uninhabitable except by penguins and seals. A smaller island, named Thompson Island, has been reported in the vicinity, but a search by the "Discovery II" over a large area in clear weather proved that no such island exists anywhere near its alleged position. Further, a running survey was made of Bouvet Island which showed previous surveys to have been quite inaccurate. Continuing in a south-westerly direction we soon afterwards met the pack and turned westwards, sometimes skirting the edge of the ice, sometimes struggling through it and sometimes steaming down long leads in "open" pack ice, until we reached South Georgia at the beginning of November. Throughout the voyage stations were taken at intervals and valuable observations made, particularly as to the distribution and stages of growth of the whale food.

As in the previous season we made a survey of the South Georgia whaling grounds and carried out similar work in the Bransfield Strait, but the greater part of the season was devoted to an examination of the fringe of the pack ice and accessible parts of the Antarctic coastal waters. Taken with the cruise from Bouvet Island this covered a distance of some three thousand miles. The hunting of whales nowadays is carried on mostly at, or near, the fringe of the pack, and the position of the ice edge at different times and seasons has an important connexion with the distribution of whales. We pushed westwards from the Bransfield Strait through the Palmer Archipelago, whose ice-clad mountains and winding channels provide some of the most impressive scenery in the world, and continued in a south-westerly direction past the Biscoe, Adelaide and Peter Islands, finally reaching a point in lat. 72° S., long. 101° W. where the ice became so heavy that we were obliged to turn back.

Returning to the South Shetlands, we continued the cruise eastwards, skirting the heavy "pressure" ice which flows out of the Weddell Sea, and revisited the South Sandwich Islands. Then after a brief visit to South Georgia we made for Elephant Island, where Shackleton's party was marooned after the "Endurance" was crushed in the Weddell Sea—and repeated the line of stations across the Drake Strait to Cape Horn.

During the season's cruise the work had not been confined entirely to stations at sea. The positions of many of the islands in the Shetland group were fixed and their coast lines surveyed. A dangerous channel known as "Hell Gates" was negotiated and charted, thus providing a short cut



THE "DISCOVERY II" IN THE PACK.

The "Discovery II" left England in December, 1929, and reached South Georgia a month later. This island is the principal centre of the whaling industry.

for whalers passing northward from the Strait. Surveys were also made of the Biscoe Islands, and throughout the voyage many thousands of soundings were taken with the echo sounding machine—an ingenious apparatus which records the depth of the water by measuring the time taken by an electrically operated hammer stroke to return from the bottom.

The purpose of this was to examine the changes which take place in the plankton and chemical constitution of the water at all depths as one proceeds up the Atlantic from the Antarctic to the tropical water, and the results when worked out will be a valuable contribution to the science of oceanography.

It is impossible at present to give an adequate account of the results of the whole voyage, for much time is needed for the thorough examination of the material, but some idea can be given of the progress that has been made. The catches of plankton show that the shrimp-like crustaceans, or "kril," on which the whales feed are not, as was previously suspected, to be found only in local concentrations, but are spread over immense areas in the open ocean. They are not to be found in all parts of the Antarctic and sub-Antarctic seas, but much has been found out as to the limits of their distribution, and since they have been taken at various stages of their growth, from the almost microscopic larva to the fully grown adult, information is forthcoming as to their rate of growth and seasons of abundance, and the geographical distribution of the different stages. A preliminary examination of the collections suggests that they are hatched in yearly batches and, by a long series of moults, grow to their full size in about two years. Data of a similar nature have been collected for the study of diatoms and constituents of the plankton.

HEAVY WEATHER OFF SOUTH GEORGIA.

In May the ship sailed for the South African coast where it was overhauled in dry dock after five months almost continually spent in stormy regions.

Secondly, much progress has been made in defining and measuring the movements of the great water masses in this part of the Antarctic, and in studying the temperature gradients and salinity, phosphate, nitrate, oxygen and hydrogen ion content of the main current systems and water layers—points which have a far-reaching importance to all life in the sea. If a line of stations is taken at right angles to a current the density of the water at all depths can be calculated and from this can be derived an accurate measurement of the speed of the current. The diatoms provide an example of the importance of the chemical constituents in the water, for they are dependant for their nutrition on the available quantities of phosphates and nitrates, and circulation of these salts has been thoroughly worked out as a result of this cruise.

Thirdly, various lines of stations have been done as a repetition of work carried out in previous years, with the object of finding, in the oceanographical conditions, a cause for the fluctuations in the distribution and catches of whales in different years. Observations are, of course, made on the whales themselves, but little can be done beyond counting the whales seen and noting their position. Direct observations on the movements of whales are impracticable, and that is why we must resort to indirect methods which aim principally at studying their environment. However, work of this kind which, though planned with a single purpose, embraces a wide range of observation and enquiry, accumulates new knowledge which may ultimately reach far beyond its immediate object.

THE BIOLOGICAL LABORATORY.

In the left foreground is a swing table which keeps level against the rolling of the ship, and in the left background is a rack for bottles of specimens.

The New Phase in Cancer Research.

By a Medical Correspondent.

Widespread interest has been aroused by Dr. Bendien's recent discoveries in the diagnosis and treatment of cancer. Our contributor discusses the significance of the Dutch physician's work, which has already presented an entirely new view of the disease and is likely to offer fresh hope of treatment.

THAT the study of cancer is entering on a new phase cannot be doubted by anyone in touch with the work which is now being done in many parts of the world. Old ideas are everywhere being tested; many have already been consigned to oblivion. On the other hand new ideas are, almost daily, being presented. Already an appearance of order can be discerned in what, yesterday, deserved no better name than chaos.

The "cause of cancer," for example, is no longer a subject of idle speculation. The day when it was possible, with a show of reason, to cast suspicion on any and every article of diet, from tea to smoked salmon, has passed. Smoking, too, is finding a verdict of not-guilty, though some of the jurymen are loathe to let the prisoner go; and alcohol has already been acquitted. On the other hand at least three entirely different causes of cancer are certainly known. No doubt exists that cancers of the skin can be caused by both radium and X-rays; that cancers of the skin in mice can be caused by the application of various tars and mineral oils; finally that certain parasitic worms can cause cancers of the stomach and tongue in rats. These recent additions to knowledge have been everywhere confirmed and are universally accepted. In a sense they mark a great stride forward; it is now possible to produce cancer *de novo* with ease and certainty. But in another sense they are exceedingly bewildering. Why, for example, should the painting of tar on the skin of a mouse usually produce a cancer whereas the painting of tar on a rat's skin is rarely attended by tumour-formation? Again, why does the worm which gives rise to cancer in rats fail to exert this effect in the case of some other animals?

Difficult Problems.

Answers to these questions are exceedingly difficult to find. Not less difficult is it to understand why the heating of certain chemical substances to very high temperatures endows them with cancer-producing power.

The work on cancer-producing substances owes its origin to a Scottish doctor, among whose patients were many workers in the paraffin-shale industry. The work was taken up and pursued actively by the late Dr. Archibald Leitch of the Cancer Hospital, who devoted most of his time to it. In the hands of his successor, Dr. Kennaway, it has been carried a definite stage further, for it has now been shown that chemical substances endowed with remarkable cancer-producing powers can be prepared synthetically.

An Important Discovery.

This discovery possesses special interest because Kennaway failed, after prolonged labour, to isolate the cancer-producing substance from tar. The suggestion is now before the medical profession that the body may manufacture chemical substances endowed with the power of producing cancer, but whether or not such manufacture represents a departure from the normal remains a matter of conjecture. The frequency with which cancer is found associated with chronic irritation lends strong support to the idea that damage to tissue may be an important adjuvant to the action of a cancer-producing substance. Dr. Leitch succeeded in causing the growth of a cancer in the gall-bladder of a guinea-pig by implanting a small pebble in the gall-bladder, yet, in ordinary circumstances, cancer never occurs in this situation in this animal.

Again, the work of, among others, Dr. Lumsden at the Lister Institute (and later at the London Hospital) has shown that the body possesses a mechanism of defence of some sort against the invasion or spread of cancer. Dr. Lumsden evolved a method whereby the production of cancer-resisting substance could be promoted in the body and was able, by means of a technique of his own, to cause the disappearance of implanted tumours in mice in a high percentage of cases. Later he attempted the production of this cancer-resisting substance in the body of a healthy animal, meaning to use the serum of the animal as a treatment for cancer. The serum, unhappily, proved highly toxic, though evidence of its efficacy was forthcoming in a number of instances. The last annual report of the British Empire Cancer Campaign

recounts the discovery by Dr. Lumsden of a substance in the serum believed to be the actual cancer-resisting element which has proved to be non-toxic. This substance has caused the disappearance of spontaneous cancer in two mice, though it failed to cause such disappearance in other instances.

While, therefore, progress has been made in this direction also, difficulties and obstacles exist which, so far, have not been surmounted. The fact that the cancer-resisting substance does not seem to be invariably successful suggests that several factors may be in play, just as the fact that certain cancer-producing substances act differently in, for example, rats and mice suggests that constitution exerts an influence which may not be less important than irritation or injury.

Meanwhile the treatment of cancer by radium is showing that whereas a primary tumour may be easily made to disappear, secondary tumours occurring in the glands may prove highly refractory. No satisfactory explanation of this difference has yet been offered, and consequently the profession is faced with yet another enigma. A whole series of questions, indeed, have been the first fruit of discoveries, each of which marks a real advance. Neither the cancer-producing substances nor the cancer-resisting substance exert effects which can be foretold with complete assurance over the field of animal life. An element of specificity is always present which may apparently be hereditary or acquired. The work of Mr. Lockhart Mummery, which is described in the report of the British Empire Cancer Campaign, leaves no room for doubt that a hereditary tendency to a pre-cancerous condition may, in the final result, be equivalent to a hereditary tendency to cancer. But this does not mean that cancer itself is hereditary.

A Clue to Cancer Producers.

One of the most interesting observations made about cancer-producing substances was that these possess a fluorescence spectrum. This was the clue which led to the finding of the synthetic compound which is cancer-producing. It may prove to be a clue to other cancer-producing agencies. Meanwhile public interest has become focussed on the work of Dr. Bendien, a Dutch physician of Zeist, who has been working along lines not wholly unrelated to the British discoveries. Dr. Bendien has discovered a method of diagnosing cancer in the laboratory by the use of a specimen of blood drawn from the patient. These specimens are submitted in the first instance to the action of certain chemical reagents, for example, acetic acid and sodium vanadate. This causes a precipitation. The precipitate is next dissolved in a two per cent solution of bicarbonate of sodium. It is then submitted to spectro-photometric examination; a series of spectrograms are made and a curve is plotted from which the diagnosis is made. Underlying this highly technical procedure is the view that cancer is a local disease which, however, cannot develop unless a specific abnormality of the serum is present. His test is directed towards the detection of the specific abnormality, not of the actual cancer.

Testing Bendien's Theory.

It was subjected recently to a test at the instance of the British Empire Cancer Campaign, which body invited Dr. Alfred Piney, secretary of the Investigation Committee of the Campaign, to visit Holland on its behalf. Dr. Piney took with him thirty-eight tubes of blood serum which had been collected by an independent physician from patients in normal health and from patients suffering from various diseases, among them cancer. The question was: Could Dr. Bendien, by means of his test, pick out the cases of cancer from the other cases? Accompanying the tubes was a sealed envelope in which was a list of the diagnoses already arrived at.

Dr. Bendien was able to examine only twenty-one of the specimens. He arrived at the conclusion that in five instances cancer was present. These findings were subsequently, by reference to the sealed list, proved to be correct. In one instance a tentative diagnosis of cancer was made. This patient had undergone an operation for the removal of the prostate gland, but it was not found possible to obtain absolute confirmation or disproof of Dr. Bendien's view.

Here, as elsewhere in the field of cancer research, a curious exception has been met with. Dr. Bendien's test is directed to the discovery of the form of cancer known as carcinoma; it will not pick out the other form of cancer known as sarcoma. There would seem to be no very clear reason for this difference, but the very fact of the difference suggests a merit rather than a demerit. It is entirely in the tradition of cancer research.

Naturally further tests of Dr. Bendien's work are about to be underatken. For if it is established that cancer represents merely a local expression of a general state a new view of the disease will have been arrived at and a new hope of treatment obtained. Dr. Bendien himself cherishes such a hope, and looks forward to the possession of a therapeutic method capable of causing the abnormal serum to become normal again and so, as it were, cutting off the necessary supplies, or rather perhaps abolishing the

essential environment of the cancer. Recent criticisms of Dr. Bendien's work suggest that the test may not be specific for carcinoma as is claimed; time must elapse before final conclusions can be reached.

It will be seen that Bendien's hope is different from that cherished by Dr. Lumsden, but is, in some sort, analogous to it. Dr. Lumsden aims at increasing a natural power and producing a solid immunity. (He has found that in the cases in which cancers in mice disappear it is no longer possible to implant fresh cancers.) Dr. Bendien aims at changing an abnormal state of the blood into a normal state. Possibly the normal state is the state of high-resistance. In that event the object of both workers is the same. The importance of the cancer-resisting substance, whatever its nature may be, is thus, clearly, very great; the new synthetic cancer-producing substance acquires from that importance an additional importance of its own. For if students of cancer are armed with weapons capable of originating the disease and of, in some cases at any rate, abolishing it, their opportunities of observation are greatly increased.

It should be added that the work at the Cancer Hospital and the work of Dr. Lumsden is entirely experimental and is, so far, inapplicable to human cases. Dr. Bendien's work, on the other hand, may prove an immediate boon if it enables the presence of cancer to be detected at an earlier stage than is now possible. For experience has shown that very early removal of a cancer is frequently attended by permanent cure.

"The Scientific World Picture of To-day."

A Forecast of General Smuts' Address.

"THE Scientific World Picture of To-day" is the title of the Presidential Address which General Smuts will deliver at the centenary meeting of the British Association this evening. According to a forecast of the speech which has been authorized by the British Association, General Smuts will discuss the effect of recent scientific progress on our conception of the world. He will point out that on the one hand we have the ordinary common-sense view of the world, which was based on practical experience and tradition, but no longer squares with the principles of science. On the other, we have the scientific world-view of the last century, which left the common-sense nature of the material world essentially unaffected, but could find no proper place for the factors of life and mind, and which thus reduced the world to the picture of a fixed deterministic mechanism.

Both common-sense and mechanistic science were profoundly affected by the new physical concepts, especially those of space-time and the quantum and their consequences. Matter in the old sense was completely transformed, and immaterial electrons and radiations took its place as the substance of the world. Our whole view of the nature of the material world seemed to be upset and revolutionized.

Building on these great discoveries a new world-view had recently arisen, which yet, like the older science, emphasized almost exclusively the physical measurable aspects of the world. The world was constructed into a system of mathematical symbols. Matter in the old sense having disappeared, the world was made out to be a highly abstract intellectualized shadow world. On this view, however, a world emerged which could not in any sense be considered real or possess any attribute of power or dynamic quality.

While acknowledging the enormous advances made by physics recently, General Smuts will suggest that it would be a mistake to emphasize them exclusively, and that the older concept of organic evolution is no less important for our world-view. By avoiding the merely physical view of the world and linking it up with the facts of biology and psychology, which are equally valid with those of physics, a world-view results which, while destructive of the common-sense view of matter, also differs from both nineteenth-century mechanism and the more recent mathematical symbolism.

It is shown that this is an evolutionary universe, essentially genetic and "holistic," that it has passed through various phases from its microscopic origins to its present macroscopic status, and that inside this macroscopic system the phase of life and mind is emerging as a new high level in the universe. It is finally suggested, as a result not only of organic evolution but also of the new physics, that the essential character of the universe does not preclude new creation, and that there are indications of a certain measure of free movement and creativeness throughout the world, which increases in life and mind, and in the emergence of new values. Within the deterministic limits of the universe the human spirit may thus have an assured status and a certain measure of creative free play.

The Peoples of Early Palestine.

By Sir Flinders Petrie.

Those who have not themselves taken part in archaeological excavation may not realize the immense amount of meticulous work entailed in collecting and interpreting the objects found. The method of historical discovery is illustrated by Sir Flinders Petrie who describes the recent work on the city of Old Gaza in Palestine.

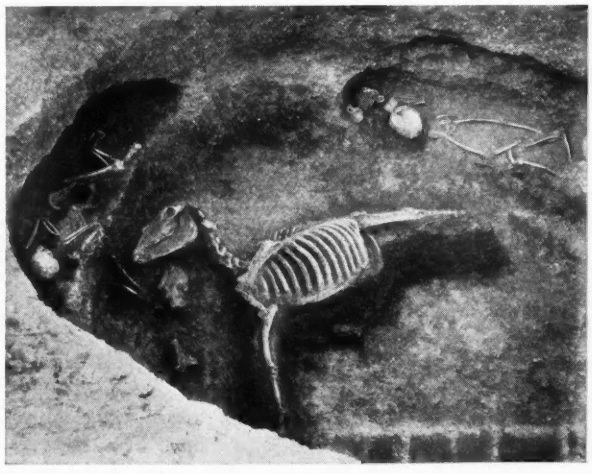
THE speed of discovery has never been so swift as in the last hundred years, and this not only in physical science but also in the science of discovering the past of man. The observation of flint implements was scarcely begun eighty years ago, the study of small antiquities is but fifty years old, the sequence-dating which sub-divides Eastern civilizations was started thirty years ago. The methods of collecting and interpreting such evidence have grown by force of circumstances, and as a recent example the work on the city of Old Gaza in south Palestine is here outlined.

This is the largest early site in that land, it is covered with shards of Bronze Age pottery and surrounded by a vast fosse. Choosing a convenient corner we began clearing about a fiftieth of the whole; walls soon appeared, and in the upper rooms were found scarabs with the name of a great Hyksos king, Apepa I, under whom the mathematical papyrus was copied. From Egyptian records this gives a date of 2250 B.C., the latest date of occupation of the city.

Why was this place deserted? The ground, though fertile, is now bare of any habitation for some miles because of malaria, so that is a likely cause. Why did malaria arise in a district which had bred a large population? It now springs from the pools in the wide stream bed adjacent, which is evidently an estuary filled with silt. So we may read here a past like that of the Cinque Ports—an estuary harbour filled up, the port destroyed, malaria come, and the people fled elsewhere. Five miles away they found a healthy site, the modern Gaza, though without any natural advantage.

The Hyksos people, thus traced by kings' names here, are always credited with the introduction of the Asiatic horse to the west. No horse is known in records before their time, but suddenly it became common afterwards. In a cemetery by our town burials of men and horses together are usual; these must be credited to the Hyksos, as the pottery is like that in the town. But with the same pottery are other burials entirely different, where the bodies are not laid composed at length, but buried with limbs spread out, as they may have died. These must be the old Canaanites who were overrun by the Hyksos migration.

The Hyksos were a nomadic people, using the local weapons and pottery, whether in Palestine or in Egypt; they cannot therefore be the builders of the substantial streets and houses of the city, or the makers of great quantities of good pottery. Evidently a sedentary people—the old Canaanites—were the civilized factor, and were dominated by the Hyksos in the Turkish manner. To these Canaanites we must attribute the solid brick buildings, with bricks twelve times the weight of ours—the shrines with ablution places covered with sea-shells, baths, hearths, privies, and an abundance of pottery. They also imported fine painted pottery from Anatolia and Cyprus.



HYKSOS HORSE BURIAL.

The Hyksos are credited with the introduction of the Asiatic horse to the west. The photograph shows a horse burial a thousand years before any known Mediterranean horse.

Earlier still there was a time of desolation, when about eight feet of soil and sandstone was denuded from parts of the country.

This break in the occupation agrees with the time of the conquest of Egypt by a North Syrian people, who are distinguished by using badges or amulets of a button form. Such are found by the hundred in Egypt at the close of the VIth dynasty, and the VIIth and VIIIth dynasties were of Syrian kings; yet there is not a single such badge found in our city, those people swept through the place without occupying it. Before this desolation and denudation we find an entirely different kind of civilization. The tombs are formed by a square pit with a slab of stone in it covering the door of a domed sepulchre. In such tombs are large jars, dishes and cups entirely different from all that came after. These people—of the Copper Age—must then be of a race with an entirely different civilization, before the North Syrian swept through the land. Their early period is certain because the denudation has in places entirely swept away such tombs, leaving only the floor, and the door slab standing up amid the desolation.

To them must be attributed a tunnel five hundred feet long, one end of which was washed away by the denudation which followed them. The tunnel ran out from the gate of the city into the country, and was coeval with the great fosse round the city. This

A PRIMITIVE FIRE HEARTH.

To the Canaanites must be attributed the solid brick buildings, with bricks twelve times the weight of ours, the shrines, hearths, privies and places of ablution.

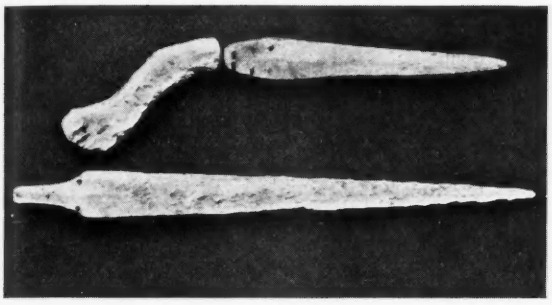
A HYKSOS GRAVE.

In the Hyksos burials the bodies were laid composed, unlike the earlier graves of the Canaanites where the limbs were spread out as the men may have died.

vast cutting for defence was therefore due to the Copper Age folk. It has a vertical drop of about twenty feet, and then a long slope up of a hundred and fifty feet at an angle of 34 degrees, on which no one could crawl. Just the same defence appears at Homs in Central Syria, so this civilization seems to have been general.

The date of this Copper Age must be before the end of the VIth dynasty of Egypt, as the VIIth dynasty wiped it out. Beads found in a tomb are like those early in the VIth dynasty, and the type of tomb is familiar in the IIIrd to VIth dynasty in Egypt. From one tomb is the fine copper rapier, yet there were traces of Neolithic handles to the pottery. So we can carry back the civilization of Palestine here to 3500 B.C., and see many civilizations before the Israelite invasion. The Neolithic age has, in the previous season, already been divided into successive styles of flint work and pottery, and we begin to see a continuous picture of changes in the past over more than eight thousand years in Palestine.

Now it may be felt that these results, cut and dried, are well enough, but what is the actual process of getting such information out of the ground? To some arm-chair folk it seems like wandering round and looking at a lot of men in holes, waiting for casual things to turn up. It really means tight organizing of some four hundred workers. They have to be carefully chosen from a much larger number that come for work; then trained and selected, requiring constant attention for the personal touch and influence to keep them up to the mark, and get the best out of their natures. Every morning at dawn one must turn out and have breakfast, so as to be ready to whistle the work to start as the sun begins to appear. There must be a cheerful greeting to all the best men, and a smile and nod to each of the children. Every digger should be told what is the purpose of his work, what he has to expect and what he must



COPPER WEAPONS.

This photograph shows a fine copper rapier from one of the tombs, and (above) a skew-handled dagger. The Copper Age was before the end of the VIth dynasty.

look out for in the course of excavating a site.

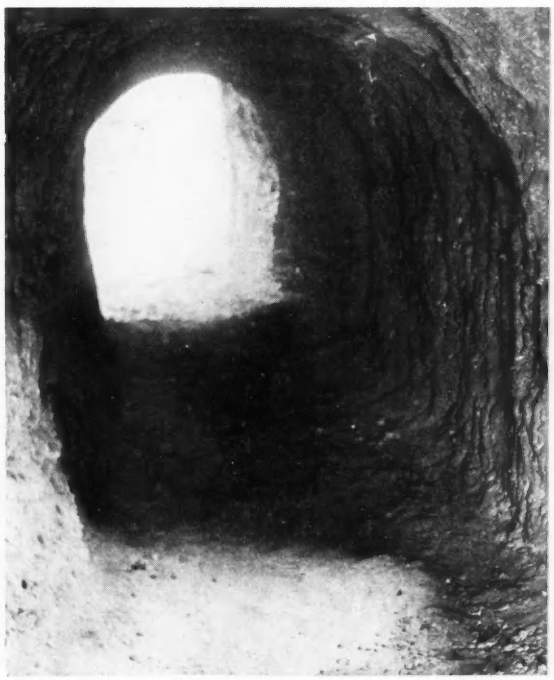
There must not be any middle-man or overseer between the English student and the labourers. He must give them his own personality of encouragement and intention; a supervisor who cannot do that ought to change his job—he is no excavator. Nor must this be unsupported by rewards. A few potsherds that are selected mean a penny or two to the man, for a necklace of fine beads five or ten shillings, for any gold or silver metal value is given. This is not merely a cold bargain; it is given cordially as a sharing of success by both parties. The more you know of the families and characters of the men, the more they feel contented, and look on you as a part of their well-being in life. Then they will follow you over deserts and across seas with cheerful confidence.

For the scientific value of the work full attention must be given to marking up the position and level of everything that can have a meaning. This needs constant observation. The sense of the place must be traced in order to interpret the meaning of each thing as found. The date of each part is keenly argued among the English staff, until decisive things may fix it. But without thus feeling the uncertainties to begin with, the crucial evidence might be overlooked. As a site is developed the really decisive points are gradually grasped, until at last work becomes a precise search to settle cardinal details for filling up the mental picture. All of this implies the organic sense of an excavation; it is like a person with whom you gradually become familiar, and can at last cross question about details.

Mapping must, of course, be constant, day by day, giving causes for speculation and showing where details have to be searched for and settled. Drawing diagram outlines of everything worth keeping gives the best form of record for its place and level. All the new varieties of pottery must be drawn, often from fragments which need holding together for measuring. Some hundreds of new pot drawings turn up each season.

When a visitor to a museum sees fine things with almost invisible cracks and patchings, he does not visualize the handful of fragments from which they have been built up, or the despair of the finder when the most telling part is missing, and must be searched for regardless of time. Three weeks of sifting were spent to recover a scrap of ivory no bigger than the tip of a little finger—but then it was the only portrait of Khufu (Cheops).

At any moment you are required to settle how to preserve something which is in perishing condition, or else how to record what cannot be preserved. The primus stove and paraffin wax is often carried out to the work, and anything up to a whole man, or whole horse, has to be paraffined before removal. Each evening comes the listing up of everything that is brought in, maintaining a record which has all to be tabulated and published and which, moreover, is demanded by the Government which permits you to work. It is a hard and active life, but so varied in its interests that one never gets stale over it, unless a site is very blank.



500 FT. TUNNEL, 3500 B.C.

To the people of the Copper Age must be attributed a tunnel five hundred feet long, which ran from the gate of the city to the country outside the fosse.

An Air Port for Central London ?

By C. W. Glover, L.R.I.B.A.

The designer of the suggested air port for central London here discusses the possibilities of the scheme, and shows to what extent an elevated aerodrome would assist in the development of modern transport.

INTERNATIONAL communication by air is making rapid progress and is contributing much to the fostering of peace and mutual understanding throughout the world. Just as the construction of good harbours and docks has been vital to shipping, and the construction of railroad termini in the heart of great cities has proved an economic necessity in railway development, so also is the establishment of air ports in centres of activity throughout the world an inevitable development of civil aviation.

Civilization has advanced with the development of transportation, and so it may be said that the speeding up and co-ordination of all forms of transport is an economic necessity. Transportation by air, road and railway is supplementary in character, though possibly competitive in certain cases on grounds of economy, speed, reliability or safety. The individual development of any one system of transport independent of the supplementary services falls far short of the object, and to-day economic considerations demand the special development of facilities for the rapid transference of goods and passengers. The logical development is, therefore, the construction of termini in the great cities of the world designed in the same convenient manner for the linking up of all methods of transport on land, water and in the air.

The rail and road facilities at present established in docks and harbours are to-day more or less adequate as a rule. There is a general tendency for the railway companies to cope with long distance transportation by undertaking extensive collection and distribution of goods with road vehicles, and new services of rail head distribution are being established. The wholesale warehouse appears to be falling out of use as consumers are realizing the advantages of ordering direct from the factory and taking delivery of the goods in bulk. This development necessitates the remodelling of most railway goods-yards and the establishment of additional warehouse accommodation with up-to-date equipment for the rapid handling of goods from the railway into the warehouse, or direct to the road vehicles. Such new warehouses can be utilized for the support of an overhead aerodrome, thus affording direct contact between road, rail and air transportation. In the event of the termini adjoining the docks, the linking up of marine transportation could be included.

It is evident that an aerodrome situated outside a town does not properly effect the desired interchange facilities, and is often an inconvenient distance from the railway terminus. A ground aerodrome established in the heart of a city must necessarily be extensive. Buildings or other obstructions round the

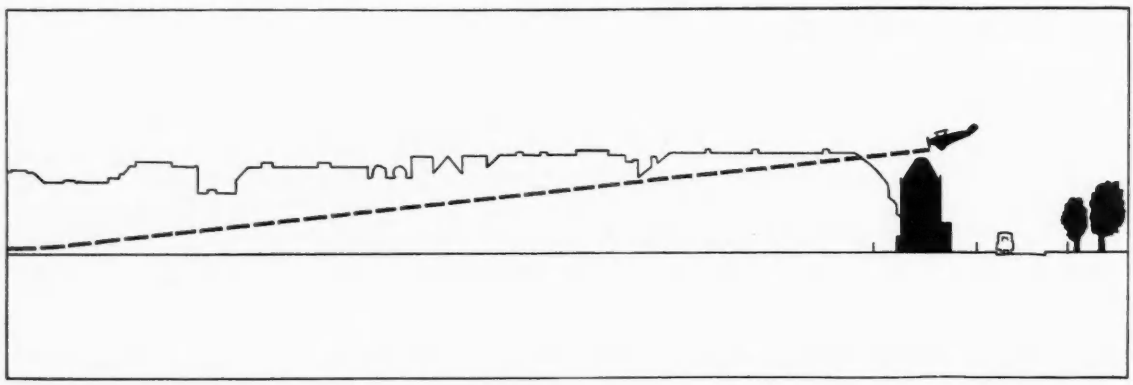
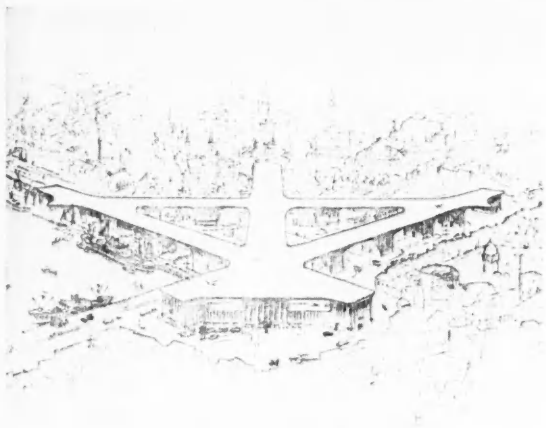


DIAGRAM SHOWING THE SPACE REQUIRED FOR LANDING UNDER PRESENT CONDITIONS.

The dotted line represents the distance of 1,500 feet required between dipping to land and reaching the ground. A "run" of 1,500 feet is necessary after landing.



A PROVINCIAL AIR PORT.

A suggestion for a provincial port which would link up the railway stations and the docks. In this way express mails could be handled with the utmost expedition.

boundary of the aerodrome restrict the effective landing area owing to the fact that the angle of approach of aircraft is usually about one in fifteen. The height of buildings in cities is usually controlled by building regulations, but it is safe to assume that nowadays in the western hemisphere a height of at least a hundred feet would be usual. This would mean that on the near side of the landing ground a strip 1,500 feet wide would not be available for landing purposes. As the usual "run" recommended is 1,500 feet this would mean that the dimensions of the aerodrome would be at least twice the minimum necessary for landing clear of obstruction. Ground aerodromes in the middle of towns will, therefore, usually be about four times the area actually necessary for landing. On the other hand, the elevated aerodrome clear of all obstructions can be kept down to the minimum area.

Aeroplanes land and take off along well-defined lanes in accordance with the direction of the wind. An elevated airport would, therefore, provide ample landing and taking-off facilities without seriously interfering with the existing use of the site over which it is built, and would not materially interfere with the free access of light and air to the building below.

In order that the airport should be international in character and suitable for the use of all types of aeroplanes, each runway should be half a mile long and two hundred feet wide between parapets. It is proposed that each runway shall be four times the length of London Bridge and nearly three times as wide; this will provide safe landing for the largest of aeroplanes. The runways will be arranged to intersect at angles of 45 degrees, so that landing and taking off can be effected in whatever point of the compass the wind may be. In the worst conditions, when the direction of the wind comes centrally between two runways, the axis of the track will only be $22\frac{1}{2}$ degrees off the line of the wind.

At night, in addition to the identity beacons, the airport would be lighted with "pilot lighting" arranged in the parapets, but the runway which lay in the direction of the wind would be brilliantly flood-lighted from the parapets. This arrangement would not only materially economize in the power required for lighting, but wou'd act as an automatic indicator to the airman of ground wind direction. The control of the lights would be operated by the wind itself through a wind vane connected to the relay automatic switch gear. The commutator switch would have a broad contact so that two adjacent lanes would be lit up while the wind remained within five degrees of the centre line between them, and the lighting on one of the lanes would not be dimmed unless the wind passed five degrees beyond the centre line. Landing and taking-off would, of course, be under the control of the officer in charge of the airport, and the light would, therefore, not be changed during an actual landing.

In large cities in which considerable air activity is to be expected, elevated airports of the wheel type are advisable, for considerable parking space is provided at the landing level on the peripheral taxiways, through which would pass the lifts to the hangars established in the supporting buildings. The scheme for London is estimated to cost five million pounds, but the development is sectionalized, each portion

THE PROPOSED CITY AERODROME.

This model of the area to be covered by the proposed city aerodrome shows the "runways" over King's Cross and St. Pancras and the supporting warehouses.

being separately justified and self-supporting.

For smaller cities, where an intense volume of aerial traffic is not to be immediately anticipated, an elevated aerodrome of the triangular type would be recommended. In this type the four main runways are not provided with independent taxiways, and parking space is restricted to small areas at the intersections. The cost of this type is considerably lower than that of the wheel type, but the runways are as many in number, as large, and intersect as before at 45 degrees. This type also lends itself more conveniently to construction by the side of a quay and over a fan of sidings interlaced with a fan of roadways. The cost of this type of airport will naturally depend upon local circumstances, but assuming conditions comparable to those in London at the King's Cross site the estimated cost of the airport would be about three million pounds.

Finally, in the words of the Aerodromes Committee, it may be urged that aviation's claim to supplement and, in part, to supercede other forms of transport is essentially the claim of speed—speed achieved without material increase of danger or discomfort. But speed in the air is of little use without corresponding speed and comfort on the ground. The aeroplanes set a standard which the aerodrome must rival. It is in large measure true to say that the future of aviation now rests on the ground.

David Davies: A Life of Discovery.

By F. J. North, D.Sc.

DAVID DAVIES of Gilfach Goch in South Wales, who died suddenly at the comparatively early age of sixty-one, was one of the most interesting personalities in the realm of palaeobotany. As a lad, working in a local colliery, he displayed an interest in fossil plants that earned for him the nickname "Dafydd Ffossil." As he grew to manhood and attained to positions of responsibility, that interest remained.

A great deal was known concerning the species and genera of plants represented by the fossils that occurred in the shales of the coal measures, and lists had been compiled showing the kinds of plants that were associated with many of the seams. But Davies undertook to try and determine the *relative abundance* of each species, each genus, and each class of plants represented at all the horizons in the South Wales coal measures where fossil plants occurred, and thus to make it possible to study the ecology of the successive forests that clothed this part of the earth's crust during Carboniferous times. With this object all his spare time for nearly twenty-five years was spent in the collection and identification of specimens.

For him it was not sufficient to visit a colliery tip or an underground exposure in order to secure a few good examples, or even a representative series; he would break the material and record the fossils exposed on every fresh surface—putting aside for preservation those that seemed of sufficient interest—until he felt satisfied that his records were sufficiently complete to indicate the relative abundance of each kind of fossil. Fortunately, Davies was more anxious to arrive at the truth than to publish his results, and he was content to work on year after year, practically unknown to the outside world; but this adds greatly to the value of his work because it means that it was thoroughly and conscientiously done. Ten years ago, the first results of the investigation—those relating to nearly thirty separate plant-horizons in the east of Glamorgan—were published in the quarterly *Journal of the Geological Society*, and we then had for the first time a true conspectus of the coal-forests of South Wales. We saw that sometimes the forests were very wet so that swamp-dwelling plants predominated, while at others they were relatively dry; and we could conjure up a mental picture of the changes that took place as subsidence allowed the water to drown each successive coal-forest prior to sealing its remains beneath layers of sand or mud.

Light was thrown upon many matters that had previously been obscure, and the practical value of the work, apart from its purely scientific interest, lay in the means it provided of evaluating the use of fossil plants in the correlation of coal seams. A more detailed account of the work appeared in the *Transactions of the Royal Society* in 1927. Immediately after the publication of his paper on east Glamorgan, Davies commenced a parallel series of investigations in the more westerly region of the coalfield, and the field work had been completed only a short time before he died suddenly, when on holiday in Norway. It is a matter for regret that Davies did not live to complete the work upon which he had been for so long engaged, but being a mining engineer he was a very methodical man, and his manuscripts were so carefully arranged that it will still be possible to publish the essential parts of his conclusions.

The Excavation of Paestum.

By Amedeo Maiuri.

Superintendent of Antiquities for Campania and Molise, Italy.

The excavation of the city of Paestum throws important new light on the history of Greek colonization in Italy. The ancient walls and forum have already been uncovered under the direction of the author, and when the work is complete, Paestum will clearly rank as one of the greatest archaeological undertakings of our time.

LESS than two years ago intensive excavation began again at Paestum. An agreement has been reached between the Antiquities Service at Naples and the public bodies of the Province of Salerno, to which belongs the credit of collecting sufficient funds to ensure the continuation of the work, and a start has been made with one of the biggest programmes of archaeological exploration which even the inexhaustible soil of southern Italy can offer. The work has been carefully considered both from the technical and administrative aspects, and it is the complete excavation of ancient Paestum : first the public buildings round the forum, and then, more gradually, the private houses. Thus the great temples of " Neptune " and " Ceres " and the " basilica," which appear detached and isolated from the complex of town buildings round them, will be linked anew by the streets which joined them in the past, and connected once more with the street plan of the ancient Greek colony and the Lucanian town which superseded it.

None of the many rich and powerful towns of Magna Graecia offers more favourable conditions of work than Paestum nor a more promising harvest of archaeological and historical results bearing upon the history of Greek colonization in Italy. The line of its walls is still clear and well-preserved ; all traces of life died out from the tenth century to the seventeenth, and only a tiny village remained ; its very desertion and burial were due to the growth of marshy lagoons and the coming of malaria. All these conditions make of Paestum a promising site for the excavation of a typical large town, and, further, a rich and powerful city which was first Greek, then Italic and then Roman, and which even in the Roman age greatly influenced the economic and social life of southern Italy.

The excavation is being carried out in the only way that the uncovering of a large town can or should be undertaken. First comes the definition of the circuit of walls. Then the revelation of the street plan in its main lines, the *cardo* and the *decumanus*. The transference of the most notable part of the ancient inhabited area to the State Domain-lands then follows and is supplemented by the steady course of systematic

THE TEMPLES AND ROSE GARDENS OF PAESTUM.

None of the many rich and powerful towns of Magna Graecia offers more favourable conditions of work than the city of Paestum in southern Italy.

excavation, year by year, of the public buildings near the forum and the great tract between the Basilica and the Temple of Ceres ; and finally, the exploration of the Greek cemetery, still unknown, and of the Lucanian cemetery, which preserves intact the valuable treasures of its underground frescoed tombs. Two years have seen the execution of two parts of this programme : the uncovering of the most important sectors of the town wall and of the great public square of the forum.

The town wall of Paestum covers a length of more than four and a half kilometres, and the city which it surrounds lies in the plain without any sensible rise of ground. Thus the wall gives to the Greek city, called Poseidonia, almost the appearance of some great Roman fortress, and forms one of the biggest works of fortification preserved to us in Greek Italy. Until the recent excavations, however, only a cursory examination of its structure had been made, and the dates assigned to its construction have proved erroneous. This could hardly be otherwise, for the wall was in our days partially buried in the fallen ruins of the upper parts of its own structure and of the towers, while a luxuriant series of tough thickets had overgrown the ruins and the very rampart-walk. The work of re-constitution was vast : clearing and removing great mounds of fallen masonry, sometimes as high as the actual part preserved ; rebuilding and re-setting in position the parts that had fallen ; the trimming-off of broken ends and the flattening of parts that the earth-filling inside the walls was causing to bulge. But thanks to it all, we may now read in the different types of structure the living drama of Paestum's history.

PORTA MARINA.

The Porta Marina turned out to be quite unexpectedly imposing. The photograph shows the Greek tower on the left which had been replaced by Italic square bastions.

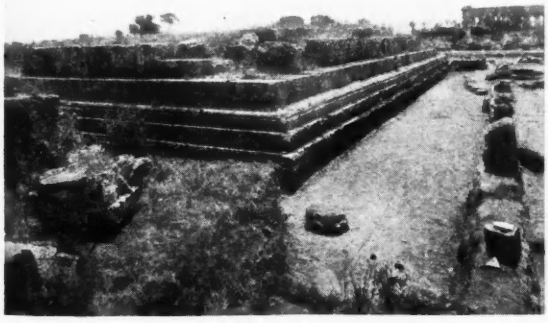
Two periods of construction can be recognized everywhere, the first Greek and the second Italic ; and they fall respectively on either side of the close of the fifth century B.C., when the city was taken by the Lucanians, who dwelt in the hinterland and the Picentine and Alburnian hills. And the work of the second period, when the wall was transformed, although carried out in the same way and with the same materials, is much larger and much more radical than a cursory examination would suggest. The wall was thickened, a mound was added behind it, quadrangular bastions were made to take the place of circular towers, and architectural members robbed from various buildings were employed to heighten the wall towers. All these facts speak of an intensive and determined defence against the reaction towards Greece which was feared in the city and in the lands which the Lucanians had conquered. Not only are two civilizations and two races at war, but we see before us the heroic first attempt to achieve unity in southern Italy earlier than the attempt made by Rome, and carried out by the Italic folk of Samnium and Lucania.

The only gate preserved out of the four which the city possessed was the Porta Sirena with its beautiful arched entrance. But trial excavations at Porta Aurea and Porta Giustizia have brought to light valuable facts about their original plan in Greek times. The Porta Marina, however, turned out to be quite unexpectedly imposing both in the character of its defences and the state of their preparation. This gate faces the sweeping curve of the great bay upon which the city stands and is well protected by a re-entrant in the wall, where it turns towards the shore in order to follow better the bank of limestone upon which the city lies. Before the present excavations nothing could be seen of this gate except the topmost courses of the bastions which flanked it. The gentle flow of the river Salso and its marshy accumulation had raised up against this wall a new bulwark, composed of river-wash, cobbles and limestone nodules ; and picks, wedges and great adzes had to be applied in order to break off this petrified skin. To-day the gate is free to its original street-level and to the very foundations of its quadrangular bastions ; and beside these, an earlier relic, a fine and large circular tower, over eighteen feet high, shows how profoundly the Italic folk modified the structure, plan and scheme of defence of the earlier Greek gate.

The worst difficulty which confronts the excavators of Paestum is the bank of petrifying limestone formed by the marsh-water; and this had to be met from place to place in following up the main street plan from north to south, between the Porta Aurea and the Porta Giustizia. A long stretch of street also opens out from the side of the temples and leads straight across the area of public buildings to the great square of the forum. Its perfect paving, in irregularly fitted slabs of travertine, the wide foot walks and the series of shops and buildings which flank it, demonstrate the rich commercial life and busy trade of the Roman Imperial age. On the other hand, the character of the Greek and Lucanian town reveals itself more clearly in the great Greek and Italic forum which may now be seen almost completely uncovered.

This great rectangular square, as large as the forum at Pompeii, still exhibits the remains of surrounding colonnade in the Doric order. Behind the colonnade is a row of offices and shops, mostly built in good squared stone, and provided with silos for corn and vats for oil, representing the two great products of the neighbouring hills and plains. Here and there are remains of public fountains and statue bases of the Roman age.

In the Lucanian age the great space of the forum was dominated by the temple which the Lucanians must have built in the third or fourth century B.C. This had a high base with Tuscan mouldings, tall columns, capitals tastefully decorated with busts of gods and metope-panels with rude but vigorous reliefs, carved with an art which betrays the Italic spirit that conceived them. The proportions of this temple are more modest, but its very position compels one to contrast it with the huge and dignified mass of the Greek Temple of "Neptune"; yet it expresses the spirit and faith of those Italic stocks who conquered the town, and on the ample border of the forum, which still remains Greek in form, it has all the significance of a nationalistic challenge.



BASE OF THE TEMPLE OF PEACE.

The Italic temple had a high base with Tuscan mouldings, tall columns, capitals tastefully decorated with busts of gods and panels with vigorous reliefs.

THE FORUM DURING EXCAVATION.

The character of the Greek and Lucanian town reveals itself clearly in the great Greek and Italic forum which is now almost completely uncovered.

Its fate was less happy than the Greek temples which it rivalled, for it was almost completely stripped of its architectural members during the Middle Ages. Its columns and capitals went to Salerno to serve in constructing a little church, and there they passed, in mistaken local tradition, for part of a temple of Pomona. They have yet to return to Paestum, and on the day when the line of columns begins to rise on the empty podium not only will a fine restoration have been accomplished but there will have been reassembled the most remarkable monument of Italic Paestum. Thus, considered from the point of view of Greek and Italic elements in the aspect of town buildings, Greek *Poseidonia* and Lucanian *Paistom* can give us, better than any other site, the essential glimpse of what part the civilization of Greek Italy played in the action and reaction of Italian and Greek.

In short, in less than two years Paestum is in a fair way to rank with Pompeii, Herculaneum and Ostia as one of the great archaeological undertakings of our time. For among all the complex monuments of Greek Italy, there was no excavation of a town to give us a more complete idea of a Greek city planned on Italian soil, of its public and private buildings, and of its ultimate history, when Italic folk replaced Greeks and were in turn replaced by Romans. Paestum should soon fill this gap, and its excavations will rank among the most ample and complete presentations of the civilization of ancient Italy. Nor must it be forgotten that the unification of Italy here revealed was the school where Rome learned how to create her greater empire.

Drumming of Woodpeckers.

By E. W. Hendy.

The means by which the drumming of woodpeckers is produced is the subject of controversy among bird watchers. There is a theory that the sound is vocal, but the author's observations show that it is entirely instrumental.

DURING the past spring and early summer I spent portions of a good many days endeavouring to get a sight of the lesser spotted woodpecker in the act of drumming, but though I saw the birds and heard the drumming on many occasions, it was not until the fourth day that I managed to catch a bird in the act. A cock lesser spotted flew over my head and settled on a dead, rotten branch of an oak some twenty yards away from me. The bird first drummed about halfway along the branch, whose length was roughly six feet, and then almost at its extremity. The middle of the branch was thicker than the end, and I at once noticed that the noise produced on the thicker wood was deeper and lower in pitch than when the drumming took place near the branch's tip ; on the thinner wood the sound was thinner and sharper both in tone and pitch.

I also observed that the violence of the blows affected the volume of sound ; the resonance diminished with softer blows. The head appeared to be blurred when the drumming was in progress. The bird remained at the end of the second branch, drumming at intervals, for about a minute. The beak appeared to me to be closed, and I watched the whole operation with field-glasses. When the bird pecked, but did not "drum," on a different branch shortly afterwards, only a very small sound was produced and the pecks were made deliberately, not quickly. I examined the branches on which he had drummed and could see no beak-marks on them. The duration of each drumming was about two seconds, and the intervals between each performance usually three seconds, but sometimes as long as six seconds.

I watched again on several days, but it was not until over a week later that I saw a bird drumming ; I could not on this occasion distinguish the sex, but I again noticed the same differences in pitch corresponding with the thickness or thinness of the dead oak branch on which the drumming took place. The extremity of this branch was very thin, no thicker than a dinner plate. The duration was again usually two seconds, but once it was three seconds. The bird hopped clumsily up the branch between each period of drumming.

Two days later I watched a male barred woodpecker drumming, again on the dead branch of an oak, with exactly the same results as those already described. The same day, a little later, I saw the hen drumming ; the duration was shorter than when the cock drummed ; again the beak appeared to me to be closed.

While watching these birds, and while listening to them drumming when they were not visible, I endeavoured to count the number of blows given during each spell. The speed is so great that this might be considered impossible, but I came to the conclusion that the separate taps in each drumming vary between nine and eleven. The hen which I saw drumming did not exceed eight taps, and listening to unseen birds drumming I noticed that the number of strokes often did not reach ten and never exceeded eleven. The times at which I watched on different days were between 8 a.m. and 6.30 p.m. (S.T.). Between these hours drumming could always be heard on some days, but there was little or no drumming in dull or windy weather, especially in the morning.

Some ornithologists, whose reputation is deservedly high, hold that the drumming of woodpeckers is vocal, produced by the bird's throat, and not instrumental. My own observations lead me to the conclusion that the sound is entirely instrumental, the result of the vibration caused by the hammering of the bird's beak upon dead or rotten wood. The differences in tone, volume and pitch which occur according to the thickness or thinness of the wood, are significant, and to my mind conclusive. If there were any vocal element in drumming, then, since the vibratory sound obviously varies with the consistency of the wood, the vocal element must be constant. But where the vibratory note produced is most tenuous, *i.e.*, when drumming takes place upon wood of extreme thinness, I cannot detect any tone which sounds vocal.

Rapid, Vibratory Blows.

Neither do I think that the fact that no dents are visible on the wood after drumming supports the theory that the sound is vocal. Rapid, vibratory blows would not mark the wood ; individually they are much less violent than the steady, deliberate blows struck when the bird is pecking.

If the sound were partly vocal, one would expect that there would be some throbbing or quivering in the bird's throat. But owing to the rapidity of movement involved in drumming it is impossible for the human eye to detect it. I doubt if even a cinema camera could satisfactorily record the throat's movement.

Man and the Dinosaur.

From an American Correspondent.

Evidence that man was a contemporary of the dinosaur in America is provided for the first time by the discovery of prehistoric animal remains together with a number of human objects. This is regarded as among the most important additions to the study of archaeology in America.

CONSIDERABLE interest has been aroused in America by a recent discovery in Nevada. While exploring Gypsum Cave, an expedition from the Carnegie Institution of Washington came upon pieces of the hide of a prehistoric creature, *Nothrotherium*, covered with masses of dark brown hair. There was also a collection of the animal's bones, including those of the right hind foot, the phalanges terminating in enormous claws, together with a number of objects attributed to primitive man. These included pieces of charcoal, burned sticks apparently used as torches, flint dart-points, and crude wooden dart shafts decorated with elaborate patterns in red, black, blue and green.

While the evidence that this cave was once inhabited by *Nothrotherium*—as well as by species of horse and camel—is interesting, the discovery is not unique, for the remains of this creature have already been found in the caves of Brazil, in asphalt beds in California and in other parts of North America. About a year ago, for instance, an unusually complete skeleton was obtained from a guano deposit in New Mexico. Moreover, the discovery of dart-points and other evidence of the presence of primitive man, though not without interest, is not of exceptional importance in itself, as the caves of south-west America are constantly yielding a wealth of material of this kind. The significance of the new discovery lies in the fact that the human objects were found associated in such a manner with the skeleton of *Nothrotherium* as to indicate that man may have been contemporaneous with the dinosaur in America, which is believed to have become extinct before the close of the Great Ice Age. After examining the material, the President of the Carnegie Institution described the discovery as among the most interesting in the history of American archaeology.

A report just received from Washington points out that, had a discovery of this nature been made in central or western Europe, it would not have been regarded as particularly remarkable, for the fossil records of these regions already afford convincing evidence that man had appeared in Europe before the close of the Great Ice Age, which ended from 15,000 to 30,000 years ago. In America, however, the position is different. The opinion has been generally held that the Americas were inhabited until a relatively late time by people who presumably came from Asia by way of Bering Strait.

Climatically, conditions in North America during Pleistocene time were very similar to those which prevailed in Europe. A great belt of ice encircled the pole, the frontal margins of which successively advanced southwards, over-riding much of the land even well down towards the middle of the two continents, only to retire at intervals leaving great areas in each covered by masses of sand, gravel and boulders of all sizes up to many tons in weight, as the melting ice released its load.

THE RESTORED *NOTHROTHERIUM*.
This drawing shows the restored prehistoric animal. The discovery of the animal's remains together with human objects indicates that it may have been a contemporary of man in America.

The great oscillations of climate attending the repeated advances and partial retreats of the polar ice sheets, variations which ranged between a cold of Arctic severity to a temperature probably milder than that now prevailing in these regions, profoundly affected the plant and animal life of the northern hemisphere. Types adapted to the milder climate which prevailed before Pleistocene time were exterminated or else crowded to warmer latitudes. Thus, northern forms migrated southwards during the cold intervals, while southern forms advanced northwards during the warmer episodes. Apparently, also, the eastern and western highways of distribution and of interchange were such, and the time involved so great, that essentially the same types of plants and animals came to occupy the two continents.

Thus it came about that the immediate progenitors of most of the mammalian forms of present-day animal life were widely distributed over the northern hemisphere during the Pleistocene, or Great Ice Age.

In Europe man was undoubtedly contemporaneous with animals of the late Pleistocene, now extinct. In America, however, although there was apparently nothing in climatic or geological conditions to have precluded the presence of glacial man, indisputable evidence of his existence has not been produced.

A DINOSAUR'S FOOT.
The right hind foot of a dinosaur discovered in Gypsum Cave, Nevada, showing the horny sheaths still adhering to the claws.

In the Don Valley, near Toronto, in ancient lake beds overlain by a hundred feet of Pleistocene deposits, fossil leaves and other plant fragments of the paw-paw and osage-orange, plants which to-day cannot grow in such northern latitudes, have been discovered. But neither in this region nor in any other region in America covered by glacial deposits have conclusive indications been found of Pleistocene man. However, in Pleistocene formations lying outside the area once covered by ice, several occurrences of human bones and of articles of human origin are known which scientists consider of sufficient importance to warrant careful examination.

Among these are human skeletons and articles of man's workmanship, in Florida, in association with bones and teeth of mastodons, mammoths and other extinct animals; flint implements, in Colorado, Texas and in New Mexico, so related to the bones of extinct bison as to indicate that they may have caused the death of the animals; and a crudely fashioned flint arrow firmly cemented in a gravel bed near Frederick, Oklahoma, and other artifacts, among bones of primitive elephants, a ground-sloth, three species of horse and two of camel, all believed to have become extinct in North America before the close of the Pleistocene period. Although scientists have long been searching the rocks and caves and scanning the canyon walls for traces of early man, information about his origin in America is meagre. Considerable interest was therefore aroused by the discovery in Gypsum Cave of fresh evidence pointing to man's contemporaneity with creatures long extinct.

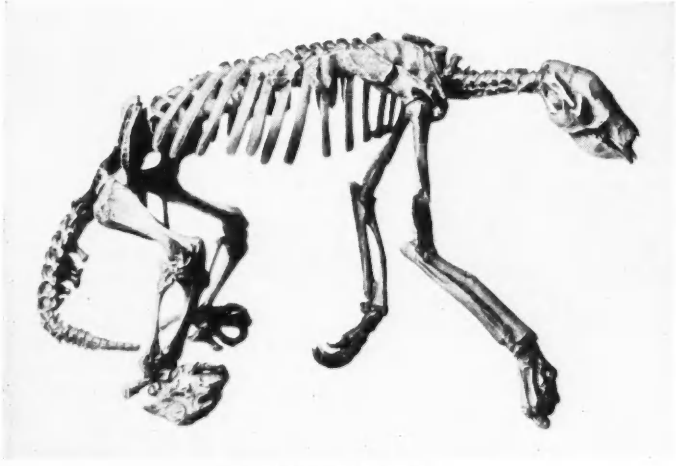
The cave is a deep, dry cavern of irregular shape, three hundred feet long by a hundred and twenty feet wide, and is about twenty miles east of Las Vegas in the foothills of Frenchman Mountain. It overlooks a wide stretch of desert and the distant gorge of Black Canyon. It contains five more or less clearly outlined and connected chambers, from the roofs of which hang huge crystals of gypsum, or selenite, beautifully formed, which give it its name.

Mr. M. R. Harrington, the leader of the recent expedition, first entered the cave as long ago as 1924 in search of traces of the early Basket Makers, a race which lived in the south-west long before the beginning of the Christian era. To his surprise he found that the cave deposits consisted, in great part, of masses of manure, well trodden down, the appearance reminding him of old horse corrals, and that numerous relics of the Basket Makers lay on the surface of the deposits. This circumstance puzzled him considerably. He knew that horses could not have been responsible, for the cave's entrance was too small to admit them; besides, the modern horse was introduced into America by the Spaniards long after the days of the Basket

Makers. Obviously the cave had been occupied by animals before the coming of these early people, but by what species he could not then determine.

Early in the spring of 1930 Harrington returned on behalf of the South-west Museum with instructions to explore the cave. A member of his party soon found a skull which proved to be that of a ground-sloth of the species *Nothrotherium*. Systematic excavation of the cave was immediately commenced.

Although the study has not yet been completed it is sufficiently advanced to have yielded certain observations and tentative conclusions of importance. A trench through the strata in Room 1 of the cave revealed traces of Pueblo Indians near the surface and of the early Basket Makers. Eight feet below, a layer of sloth manure appeared. Immediately below this layer, which was undisturbed, were found fragments of charcoal and a piece of wood which had undoubtedly been shaped by man.



A COMPLETE SKELETON.

A complete skeleton of *Nothrotherium* obtained from a guano deposit at Aden Crater, New Mexico. Fragments of epidermal structures still adhere to the skull, shoulder blades, ribs and feet.

In Room 2, beneath a deeply buried layer of matted sticks containing sloth manure, and at a depth of from eight to ten feet from the surface, some fragments of painted dart-shafts were recovered. Room 3 also yielded interesting evidence, for in the bottom of a rock slide some flint points for similar darts were obtained, and on the surface of the same slide, a short distance from one of the flints, lay the skull of a fully grown sloth. Room 4, the largest of the chambers, is approximately one hundred and twenty feet long, sixty-five feet wide, and is sixty-five feet below the level of the entrance to the cavern. In this room, definitely embedded in a layer of partly solidified gypsum, in a zone of burnt manure and ashes, lay a stone dart-point of an *atlatl* or throwing stick. Within two feet of this object and in the same layer a leg bone of a sloth was found, while in the layer of burnt manure above and not more than six feet from the dart-point lay the charred and broken leg bones of a slender-limbed camel.

Only one piece of evidence was found in Room 5, but this was valuable. Here, at a depth of twenty-two inches, capped over with unbroken layers of cave *debris* and sloth manure, the bones of a young sloth were discovered. Within five inches lay two small pieces of arrow-cane, burnt at both ends, and so placed that apparently they could not have reached the vicinity of the bones except by having been deposited at the same time.

Careful as the excavators are, they were continually on the alert for evidence that might cast doubt upon the reliability of their discoveries, such as objects clearly of modern date in apparent association with sloth remains. At one time they found a bullet embedded several inches in ashes which had resulted from the burning of sloth manure; later they came upon a tin deep in a crevice such as had, in other cases, yielded darts and traces of the sloth. Such finds were of little significance, however, because the weight of the bullet would carry it into the soft ashes from the surface. Another puzzling find was an Indian bean with a handful of other seeds buried a long way down below a layer of sloth manure in a deposit altogether too early for the development of agriculture in America. But the seeds showed signs of gnawing by mice and were found in an open crevice through which a mouse could easily find its way from the surface.

Consideration of all of the evidence so far collected at Gypsum Cave points to the probability that man and the dinosaur were contemporaneous. Indeed, it has been suggested that a group of early Americans may have come upon a herd of sloths in this vast underground cavern and have exterminated them. Such an occurrence would explain the abundance of darts. More work must be done before the date of the passing of these animals can be determined and with it the fixing of the time of man's appearance in America.

Book Reviews.

Early Man, His Origin, Development and Culture. By G. ELLIOT SMITH and Others. (Benn. 8*s.* 6*d.*).

In this volume appear six lectures on early man delivered under the auspices of the Royal Anthropological Institute. They are of a type unfortunately all too rare in science. Each by a recognized authority on the specific subject of the lecture, summarizes critically, but popularly in the best sense, the results of research up to the date of delivery. The lectures were in no sense academic. The broader aspect of the problems discussed was kept in view, and where appropriate the author glances at the practical bearing of these studies. Thus Professor Elliot Smith in his introductory lecture on the evolution of man is at some pains to point out how the study of the comparative morphology of anthropoids and man in the light of recent discoveries of new types such as Peking Man—more specially in so far as they add to our knowledge of the development of the brain—is giving precision to our study of the general problem of the origin and descent of man; while the study of the evolution of racial types is narrowing down the area to which we must look for the place of man's origin. Sir Arthur Keith, on the other hand, in dealing with the evolution of races, past and present, defines the function of race in the evolutionary process, and stresses its practical bearing on the problems with which the modern world is confronted in racial antagonism and national aspirations. Professor Parsons expounds a fruitful application of new methods to the study of physical characters as exemplified in an analysis of racial characters in the Englishman and points out the line of modification now taking place, at least in one section of the population. Three lectures deal with the cultures of early man. Mr. Miles Burkitt in "Most Primitive Art" illustrates his thesis of the existence of "art groups" in palaeolithic and primitive art by reproductions of some interesting examples of French and Spanish cave art, which had not previously been published; while Mr. Harold Peake, in dealing with the beginnings of agriculture, demonstrates the bearing of the study of the origin of wheat and other cultivated grains on the question of the relative antiquity of civilization in Egypt and Mesopotamia. In certain respects the most interesting contribution is that of Professor J. L. Myres on the discovery and early use of metals, which has been expanded into two chapters dealing respectively with the precious and the useful metals. He ranges over a wide field in both the geographical and the cultural sense, and shows how the use of metals affects the life of primitive man, not merely in regard to his technology and economics, but on every side, including his religion and his social and international relations.

Watchings and Wanderings among Birds. By H. A. GILBERT and ARTHUR BROOK. (Arrowsmith. 10*s.* 6*d.*).

The authors are well known for their careful studies and photographs of bird life. This book begins with a rhapsody on the Pembrokeshire coast, which is indeed both remarkable for its cliff scenery and for the abundance of birds, such as raven, peregrine and buzzard, which are unknown or scarce in many other districts. The authors have in one year found on this coast thirty-nine ravens' and eighteen peregrines' nests. Buzzards, as we have ourselves observed, are innumerable. But twenty years ago, we are told, it was not easy to find a nest of any of these species. The authors think that choughs are gradually being displaced by jackdaws, but this is a matter of controversy. Perhaps the chough is a species which, like the corncrake, is subject to periodical decreases and increases. That the egg collector can be absolved from blame for its decrease, a perusal of dealers' catalogues makes us doubt.

The description of a visit to Hungarian lakes whets the bird-lover's appetite. It is racily written, and introduces us to great white and purple herons, spoonbills, ibises, little bitterns, penduline tits, storks and many others.

The authors saw a female stork fill herself up with water from a pond close by her nest and then return and bring all the water up again, pouring it over her nestlings, who opened their beaks and caught as much of it as they could. Mr. Oliver Pike has described how he saw ravens bring water to their young who were suffering from heat, and we have seen grey wagtails dip food in water before bringing it to their nestlings, but there are few records of parent birds carrying water to young in the nest. There are excellent photographs of spoonbill, great white heron, stork and ibis, but more detailed observation on some of the rarer species seen would have been welcome. We are glad to learn that the gannets on Grassholm are increasing; thanks to the efforts of the British Navy and others, the colony was saved last year from extermination by fire. The chapter on the Orkneys is rather discursive. It is disgusting to read that "a certain egg collector" had been taking all the first layings and all except two of the second clutches of hen harriers. "Such men," says the author, "are rare." Perhaps, but one is too many.

Discussing the status of certain species in mid-Wales during the last thirty years, the authors find that the black-headed gull is an entirely new summer migrant; that kite, peregrine, raven, buzzard, carrion crow and curlew have increased but that sparrow-hawk, peewit, partridge, heron, moorhen, landrail and black game have decreased; the numbers of merlin and kestrel are stationary. They suggest that the prohibition by law of the pole-trap has in part prevented the destruction of raptorial birds by this means. As to the kite, its alleged increase is likely (as the authors hint, and we can corroborate from experience) to be nullified by the activities of collectors. We notice in places some needless repetition. But the book is attractively written and will be welcomed by every field naturalist. All the photographs are magnificent. There is no index.

Skara Brae, a Pictish Village in Orkney. By V. GORDON CHILDE. (Kegan Paul. 31*s.* 6*d.*).

Skara Brae, the prehistoric village site on Skail Bay in Orkney, which has now been made safe from wind and wave by the Office of Works and has been excavated for three successive seasons from 1928 to 1930 under the supervision of Professor Childe, has a twofold interest for the archaeologist and the student of culture. It is the only site north of the Alps on which it is possible to see the actual habitations of prehistoric man and not merely their foundations. The walls of his dwelling places still stand eight and nine feet high; and between the house walls and the retaining walls built here and there to keep out the refuse-heaps characteristic of the site, run the covered alley ways of the village. Within the walls the life of the people is completely revealed. Here are the byre and the family hearth under the one roof, the seating place for the

men, the stone bed-place, the dressers, niches and ambries for personal possessions, the chambers in the thick double walls, the drains and, perhaps, the water tanks in the floor in which limpets and shell-fish were kept alive until required for food. The utensils and personal possessions scattered here and there in disorder, including the beads of a necklace broken as the owner escaped through the doorway of the hut, bear witness to the hasty abandonment of the settlement in the face of some disaster, possibly one of the tempests, common in this area, of exceptional violence.

The culture of Skara Brae is essentially neolithic, that is to say, the inhabitants were living in a stone age, untouched by outside influence, whatever may have been the actual date of their occupation. This is the second aspect in which the site is of especial interest. It affords a striking example of the adaptability of man to the conditions of his environment. Here in Skara Brae where there was no timber, and the community was entirely dependent on its own resources, owing to the lack of communications with outside sources of supply, we find furniture, and utensils, commonly fashioned of wood, made entirely from stone.

As regards dating it is obvious that the site was occupied for a very considerable period. In the course of the excavation no less than four successive stages of occupation were brought to light, although from first to last the culture was essentially one. In this period a sufficiency of time elapsed for the accumulation of fourteen feet depth of midden deposit. From internal evidence there is little to suggest an absolute dating. An isolated culture of this relatively simple type might have existed at any time between the first coming of the peoples associated with the cist type of burial, which is evidently a basic element of the population and their culture, and the Viking burial of the ninth century which sets a limit to the latest possible dating. In a chapter on the age and affinities of the site, Professor Childe has given his readers an admirably lucid analysis of the chronological evidence bearing upon the problem. In his view, this points to the conclusion that the settlement was contemporary with the late Bronze Age of Northern Europe, possibly in absolute dating about 500 B.C.

This brief reference to the main points of Professor Childe's results can hardly indicate, even by suggestion, the meticulous care with which he has carried out the work of excavation and the insight with which he has pieced together and interpreted the details of his record. His book presents in detail a mode of life which would have little attraction for the fastidious; but as a setting for its own particular type of culture Skara Brae is no less eloquent than Knossos or Pompeii.

From Telegraphy to Television. By LT.-COL. CHETWODE CRAWLEY. (Warne. 6s.).

Television To-day and To-morrow. By SYDNEY A. MOSELEY and H. J. BARTON CHAPPLE. Second Edition. (Pitman. 7s. 6d.).

The story of electrical communications is accurately and attractively sketched by Colonel Crawley in his new book. He was one of the pioneers of wireless in the Navy thirty years ago and was in close touch with the rapid developments of the Marconi system. In his book he goes back to the origins of telegraphy and to the first practical English telegraph, installed by Wheatstone of King's College and his medical friend Cooke on the London and Blackwall Railway in 1838. Colonel Crawley explains the working of a land telegraph and describes the Post Office system. Then he passes on to submarine cables and telephones, in each case giving a short history and an account of modern practice. He observes that in the United States there are seventeen telephones to every hundred persons while in Great Britain there are only five, but he seems to think that this is no way the fault of the Post Office. The reason for the difference cannot be the greater wealth of America, for Denmark, Sweden and Norway all make far more use of telephones than we do. The latter half of the book is devoted to the marvellous rise and growth of wireless, broadcasting, wireless telephony and television, with a few personal reminiscences at the close. Colonel Crawley is a pleasant writer, and his well illustrated book will interest the layman.

Mr. Moseley and Mr. Chapple in their new book, which has quickly reached a second edition, give a clear semi-technical account of television, especially of the Baird system which has evolved at a great pace in the last five years despite many difficulties. The book is fully illustrated with diagrams and photographs, and will enable a careful reader to grasp the main principles of Mr. Baird's inventions. There can be little doubt that television has a great future before it. Scenes have been transmitted across the Atlantic and living pictures have been shown by this means at a London theatre as part of the regular programme. In the future the television receiving set will probably be as familiar in the household as the wireless set. This book is a handy survey of what has so far been achieved.

Dartmoor in all its Moods. By DOUGLAS GORDON. (Murray. 9s.).

In his foreword Mr. Gordon says he has avoided those fields which have already been explored by former writers. Nevertheless he has, out of his intimate knowledge of the moor, contrived to give us a fascinating picture which will interest alike the sportsman, the naturalist, and the country lover. He is very emphatic in his views upon the subject of swaling, or heather burning, which on Dartmoor is apparently carried on regardless of the prohibitory regulations and the Wild Birds Protection Acts. Swaling is necessary in order to provide pasturage, but if uncontrolled it devastates the moorland. Mr. Gordon suggests that it should be forbidden by law after 1st April.

It is pleasant to learn that ravens are extending their breeding haunts not only along the coast but also in inland woods. As to the buzzard, the author states that though it increased its range during the war its numbers are now approximately the same as before. For this he blames, and in our opinion justly, the gamekeeper, the irresponsible observer, and also that pest, the egg collector. His depredations (which usually comprise the acquisition of a series of clutches), though disguised under the cloak of scientific research, are both selfish and unnecessary, for the fullest information as to the eggs of British birds is already available. Mr. Gordon urges bird societies to place protection of birds before all things. Unfortunately they do not always do so; some prefer to wink at or even encourage the pilferings of the collector. He also suggests that a closer watch should be kept on taxidermists. The Wild Birds Protection Bill of 1927 made it compulsory on all taxidermists to keep a detailed register of birds, etc., brought to them, but unfortunately the Bill never became law.

Mr. Gordon also deplores the destruction of rare birds for the purpose of identification. ". . . The sacrifice of a 'rarity'

purely for identification purposes cannot be justified. The argument that . . . its 'occurrence' in some particular locality can be established by no other means provides . . . a poor excuse. . . . Is the knowledge that a certain species once accidentally alighted in any given county so invaluable to posterity? The claims of posterity would be better served by allowing the bird to live, its destruction being the most effectual means of preventing its recurrence. . . . If only ornithologists would concentrate on the preservation of our fast-disappearing avifauna rather than upon freak occurrences and the establishing of records, great service might be rendered to the cause (of bird protection)." These views, which are those of a man of broad outlook, who knows his subject, deserve serious attention by scientists and others.

The book is full of intimate and first-hand observation, not only of birds, but of vipers, badgers, foxes, hedgehogs, rabbits and hares, and indeed all the denizens of Dartmoor. It also contains much information about the customs and superstitions, both curious and uncanny, of the Dartmoor folk. The descriptions of scenery are often vivid and sympathetic; in particular, his pictures of the moor in autumn and in snow and frost have great beauty. We regret the omission of an index.

Advancing Science. Being Personal Reminiscences of the British Association in the Nineteenth Century. By SIR OLIVER LODGE. (Benn. 6s.).

Sir Oliver Lodge's new book is unique. Only he could have written it with such authority and precision. For here he reviews the history of modern science as reflected at the yearly gatherings of the British Association. He was selling potters' materials for his father's firm in 1873 when as a youth of twenty-two he seized the opportunity of attending the Bradford meeting and there became an ardent disciple of Clerk Maxwell. From that day to this Sir Oliver has been a constant supporter of the British Association. It is natural enough that no meeting has ever impressed him quite so much as the first, although it was "a mathematical orgy" with no excursions to relieve the sternness of the first week's papers. He devotes an interesting chapter to the Montreal meeting of 1884, the first held in the Dominions. At Montreal he gave a notable lecture on "Dust"; he warned the citizens not to let their fine city be plagued with smoke, but the warning, he says, was ill received. The Bath meeting of 1888 was noteworthy for the discussions of electric waves in which Sir Oliver took a leading part. Attention was drawn to Hertz's recent discoveries, and Lord Rayleigh and Lord Kelvin contributed to the debates. The main principles of wireless telegraphy were then being formulated, as Sir Oliver shows in a valuable table of dates. He brings the story to a close with the Bradford meeting of 1900 and indicates briefly the revolutionary new doctrines—especially Planck's quantum theory—which since then have opened fresh worlds to the physicist. It is a valuable little book.

Eton College Natural History Society. Annual Report, 1930-31. (Price to non-members, 5s.).

Those who remember the amusement and contempt which an interest in natural history aroused at most public schools a few years ago will detect a new attitude in this report. "Bug hunting" used to be the object of nagging and bullying; now, apparently, it is becoming respectable and at Eton more than one hundred boys belong to the Natural History Society. Remarkable progress is shown by the fact that this report has double the number of pages of the first volume issued a year ago. The activities of the Society are sufficiently wide to include astronomy.

Among several articles the most interesting deals with "The Role of the Cinema in Biology" by Dr. Neil Chrystal, who discusses the objects to be achieved by natural history films, the choice and treatment of the subject and the role of the talking picture in this class of work. The author points out that the film cannot be expected to take the place either of practical work in the laboratory or of first-hand observations in the field. But once a solid foundation of research has been laid, the film provides the means of obtaining a permanent record, for instance, of an insect's behaviour at various periods in its life; and some of these pictures may be particularly valuable, since the actions they demonstrate may not always be visible under natural conditions. The talking scientific film presents many problems. Dr. Chrystal's suggestion that "the talking version of any film is never quite as effective as the same film illustrated by spoken comments" is open to question. Admittedly it would be difficult to reproduce an insect's sounds, but we recall several nature films where the natural sounds have been reproduced most effectively, while the commentator is invariably a most tiresome fellow; and a running commentary nearly always detracts from the "atmosphere" of the film, calling to mind the lantern lecture of bygone days. The Annual Report contains some really excellent half-tone illustrations and many line drawings in the text.

The Quest for Power. From Prehistoric Times to the Present Day. By HUGH P. VOWLES and MARGARET W. VOWLES. (Chapman & Hall. 15s.).

Mr. and Mrs. Vowles have done a service to the average reader in preparing their "account of man's endeavour through the ages to augment his own bodily power." They are technically well equipped, they write clearly and agreeably, and they have planned the book judiciously. A hundred pages or so are given to the ancients, from the cave-man to the Romans; a hundred more to a swift survey of the age of steam and electricity in which we live; and a third hundred to the materials of power—coal, oil and the metals—with a brief speculative note about the future. The ancient world, as the authors observe, had gone far in engineering, but depended in the main on human toil and lacked our instruments of precision and our advanced mathematics. Watt's improved and efficient steam engine opened a new period in world history; the dynamo—virtually invented by Faraday a century ago—accelerated enormously the developments made possible by steam; and the internal combustion engine effected a third revolutionary advance. Of these and other modern marvels, which we accept as a matter of course, the authors write competently. They are well acquainted, too, with the fuel and metal industries, and are not unduly optimistic as to the immediate future of either the hydrogenation of coal or the low-temperature carbonization processes. In conclusion, they refer to some of the ingenious new schemes that have been propounded for utilizing the heat of the sun or the earth, or the relative warmth of the Arctic seas, and so on. And they do not fail to remind the engineer that the power problem has its human side, which is becoming more and more insistent on recognition. The book is well produced and admirably illustrated.

ry Society.
report has
ued a year
ly wide to

with " The
rystal, who
ry films, the
the talking
hat the film
ctical work
the field.
id, the film
or instance,
life; and
e, since the
sible under
sents many
king version
illustrated
mittedly it
ut we recall
been repro-
nvariably a
tary nearly
n, calling to
nual Report
and many

the Present
V. Vowles.

erage reader
through the
technically
d they have
so are given
a hundred
lectricity in
of power—
note about
bserve, had
on human
ur advanced
eam engine
o—virtually
enormously
the internal
dvance. Of
as a matter
ey are well
ies, and are
re of either
arbonization
he ingenious
ing the heat
f the Arctic
the engineer
is becoming
ook is well